

ADVANCE COPY

# SCIENCE

30 September 1955

Volume 122, Number 3170

<b>Editorial</b>	Dividend at 100 percent a Year .....	581
<b>Articles</b>	Recent Geology of Cane Wash, Monument Valley, Arizona: <i>C. B. Hunt</i> ...	583
	Speculations on Hazards of Exposure to Radiations: <i>J. Keosian</i> .....	586
	Oscar Orias, Physiologist: <i>C. McC. Brooks</i> .....	587
<b>News of Science</b>	U.S. Geological Survey, 1956; News Briefs; Scientists in the News; Necrology; Education; Grants, Fellowships, and Awards; In the Laboratories; Miscellaneous .....	588
<b>Reports and Letters</b>	Alkaline Phosphatase in the Kidneys of Agglomerular Fish: <i>J. B. Longley</i> ...	594
	Ultraviolet Irradiation of Pyrimidine Derivatives: <i>A. M. Moore and C. H. Thomson</i> .....	594
	Tartronate as a Possible Coenzyme of Oxalosuccinic Carboxylase: <i>L. G. Wesson</i> .....	595
	Occurrence of Diffusible Auxin in <i>Psilotum</i> : <i>W. P. Jacobs</i> .....	597
	Isomeric Substituted-Vinyl Phosphates as Systemic Insecticides: <i>J. E. Casida</i> .....	597
	Atomic Charges in Monosubstituted Benzenes: <i>R. T. Sanderson</i> .....	598
	Polygonization of a Plastically Bent Sapphire Crystal: <i>M. L. Kronberg</i> ....	599
	On Responsibility of Scientists: <i>R. Bloch; E. Teller</i> .....	600
	On "An Application of Statistics": <i>A. E. Waugh</i> .....	601
	Proliferation of Mature Fruit Pericarp Tissue Slices <i>in vitro</i> : <i>C. A. Schroeder</i> .....	601
<b>Book Reviews</b>	<i>Approximations for Digital Computers; Speech: Code, Meaning, and Communication; Methods of Quantitative Micro-Analysis; Elementary Theory of Nuclear Shell Structure; Canadian Cancer Conference; Letalfaktoren in ihrer Bedeutung für Erbpathologie und Genphysiologie der Entwicklung; Radiation Biology; Aux Confins de la Vie; Books Reviewed in The Scientific Monthly; New Books; Miscellaneous Publications</i> .....	602
<b>Scientific Meetings</b>	Pacific Division Meets; Meeting Notes; Forthcoming Events .....	606

*fills every research requirement*

**Leitz**

## **ORTHOLUX** RESEARCH MICROSCOPE

**IDEAL FOR RESEARCH**—The Leitz ORTHOLUX microscope is highly valued in leading research laboratories because of its versatility, image quality and unique advantages. The ORTHOLUX incorporates the most refined details of advanced optical design and has its own built-in illuminating system for transmitted or incident light.

**WITHIN SECONDS** the ORTHOLUX with easily attached Leitz accessories adjusts for: bright and dark field • polarized light • phase contrast • fluorescence microscopy • photomicrography • table and wall projection • ultropak illumination for reflected light.



**COMFORT AND EASE OF OPERATION**—ORTHOLUX design permits operation of the microscope in a relaxed position with unobstructed stage in clear view and fingertip control of low position, table-top adjustment knobs. And... the dual controls move only the ball-bearing stage—they do not alter the favorable eyepiece height—providing fatigue-free operation.

Send for ORTHOLUX brochure.  
See and examine the  
ORTHOLUX microscope soon.

**E. Leitz, Inc., Dept. SC-9**  
**468 Fourth Ave., New York 16, N. Y.**

Please send me the Leitz ORTHOLUX brochure.

Name

Street

City  Zone  State

**E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N. Y.**  
Distributors of the world-famous products of Ernst Leitz, Wetzlar, Germany  
**LENSES • CAMERAS • MICROSCOPES • BINOCULARS**

# Saunders books

## Odum—

### Fundamentals of Ecology

Since its publication, Odum's *Fundamentals of Ecology* has established itself as the definite leader in its field as shown by enthusiastic reviews and widespread adoption by teachers of ecology. Here are some typical reviews.

"Professor Odum's book has great attractions. It is not too long or expensive, cites plenty of recent research on live topics, successfully deals with population ecology, and is written in a lively and even provocative style and illustrated with very carefully chosen examples."

*JOURNAL OF ANIMAL ECOLOGY*

"Dr. Odum . . . has successfully marshaled the rudiments of ecological knowledge into a well organized, readable basic text."

*ECOLOGY*

"This book commends itself to evolutionists as a radical and refreshingly dynamic approach that emphasizes principles and concepts."

*EVOLUTION*

By EUGENE P. ODUM, Ph.D., University of Georgia, Athens, Georgia. 384 pages, with 119 illustrations. \$6.50.

*a  
balanced  
synthesis  
of the  
entire field*

*a  
laboratory  
manual  
comparing  
systems*

## Walker—

### Vertebrate Dissection

This practical lab manual compares the systems of three levels of organisms by thoroughly studying the dogfish, mudpuppy, cat and rabbit. It helps the student understand the major anatomical transformations that have occurred in the vertebrates in the course of their evolution.

Directions for dissection are precise and helpfully illustrated with labeled drawings. Summary paragraphs accompany the instructions and point out to the student how this particular species conforms or deviates from the general group. The material does not replace the textbook but helpfully supplements it. Appendices explain the preparation of specimens.

This manual will accompany any comparative anatomy text and is easily adapted to the emphasis and length of your particular course.

By WARREN F. WALKER, JR., Ph.D., Associate Professor of Zoology, Oberlin College, Ohio. 331 pages, illustrated. \$3.50.

## W. B. SAUNDERS COMPANY

West Washington Square

Philadelphia 5

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of 3 March 1879. Annual subscriptions: \$7.50; foreign postage, \$1; Canadian postage, 50¢.

30 SEPTEMBER 1955

579

## PHOTOVOLT Electronic pH METERS

A complete line of pH meters incorporating modern electronic tubes and circuits, simple in operation and maintenance, featuring sealed amplifier plug-in units.



MODEL 115



MODEL 110

### Line-Operated Model 115

- Single range 0-14, scale length 4", accuracy 0.05 pH unit.
- Fully stabilized for wide range of line voltage fluctuations.
- Unprecedented in compactness and low price of only

Write for Bulletin #225

\$115.—

### Line-Operated Model 110

- Single range 0-14, scale length 7", accuracy 0.02 pH unit.
- Available also with shielded compartment, with base board and carrying hood, with bottles and beakers, additional price \$40.—

Write for Bulletin #105

\$185.—

### Battery-Operated Model 125

- Single range 0-14, scale length 5 1/2", accuracy 0.03 pH unit.
- Only 3 batteries, standard radio type, 2,000 hours of service.
- Carrying frame for instrument, beakers, and bottles, price \$20.—
- Stabilized power supply unit available for alternative operation from 110 volt AC line, price \$48.—

Write for Bulletin #118

\$145.—

### Battery-Operated Model 125-B for Blood pH

- Scale length 2 3/4", expanded five-fold for blood pH tests.
- Accuracy 0.01 in pH 6-8 range, 0.05 in pH 2-12 range.

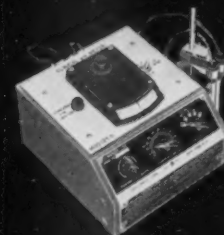
Write for Bulletin #122

\$165.—

Prices include PHOTOVOLT glass electrode and calomel electrode. Electrodes of other makes usable, adapters available.



MODEL 125



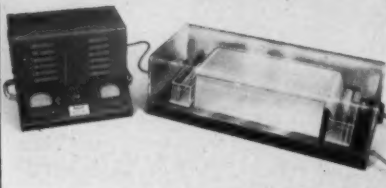
MODEL 125-B

**PHOTOVOLT CORPORATION**  
95 MADISON AVENUE, N. Y. 16, N. Y.

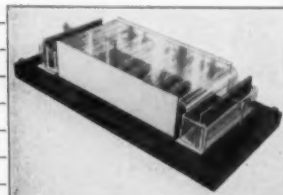
The **Reco**

**PAPER ELECTROPHORESIS Apparatus**

Reco specializes in the manufacture of Chromatographic equipment. Write for General Catalog.



With special water cooled surface for paper or solid media to prevent loss of water by evaporation or destruction of the sample by heat



### SPECIAL FEATURES

**Water Cooled Surface for Paper or Starch...** The platform surface, on which buffer saturated filter paper or starch is placed, is cooled by circulating water (see illustration) to reduce evaporation and minimize change in buffer solution during operation, thus permitting use of high voltages.

**Power Unit** supplies 0-720 volts at 200 milliamps continuously variable, with 3 1/2-inch voltmeter and 3 1/2-inch double scale milliamp meter reading 0-20 and 0-200 milliamps for accurate current measurements. Direct current measure-

ments. Direct current ripple is reduced by means of a choke-capacitor filter. Multiple power outlets available at nominal extra cost. For 115 volts AC.

**Anti-diffusion plates** in electrode troughs reduce any changes in electrolyte at the paper due to electrolysis.

**Platform surface** is quickly adaptable for either paper or starch paste by means of end gates. Electrode vessels easily dismantled for cleaning.

MANUFACTURED BY

Write for Brochure SS-10

**RESEARCH EQUIPMENT Corporation**

1135 THIRD STREET • OAKLAND, CALIFORNIA



AMERICAN ASSOCIATION  
FOR THE  
ADVANCEMENT OF SCIENCE

Board of Directors

GEORGE W. BEADLE, *President*  
PAUL B. SEARS, *President Elect*  
WARREN WEAVER, *Retiring President*  
WALLACE R. BRODE  
JOHN R. DUNNING  
MARK H. INGRAHAM  
PAUL E. KLOPSTED  
CHAUNCEY D. LEAKE  
MARGARET MEAD  
THOMAS PARK  
LAURENCE H. SNYDER  
PAUL A. SCHERER, *Treasurer*  
DAEL WOLFE, *Administrative Secretary*

DAEL WOLFE, *Acting Editor*

CHARLOTTE V. MEETING, *Assistant Editor*

Editorial Board

MARK H. ADAMS      KARL LARK-HOROVITZ  
WALLACE R. BRODE      EDWIN M. LERNER  
BENTLEY GLASS      WILLIAM L. STRAUS, JR.

Editorial Staff

PEARL BOSIER, CATHERINE H. BORRAS, BEVERLY  
BUHNERKEMPE, SARAH S. DEES, OLIVER W. HEAT-  
WOLE, M. DALE HOOPER, YUKIE KOZAI, ELLEN E.  
MURPHY, ROBERT V. ORMES, BETHSABE PEDERSEN,  
JACQUELYN VOLLMER

EARL J. SCHERAGO, *Advertising Representative*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

Change of address: The notification should reach us 4 weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: \$7.50; foreign postage, \$1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.



## Dividend at 100 percent a Year

In dollars and cents, how much does society get back for its investment in research and development? Raymond Ewell of the National Science Foundation recently examined this question [*Chemical and Engineering News* 33, 2980 (1955)]. Reasonable assumptions led to the estimate that in the United States the return averages from 100 to 200 percent a year for 25 years. Over the course of 25 years, society gets back \$2500 to \$5000 for every \$100 spent on research and development. Some of Ewell's figures are pretty speculative, but even if there is a large error in the estimated return, research and development appears, on a strictly financial basis, to be a first-class investment. Confirmation came from a chemical company and an oil company that had independently estimated their returns at 200 and 160 percent per year, respectively.

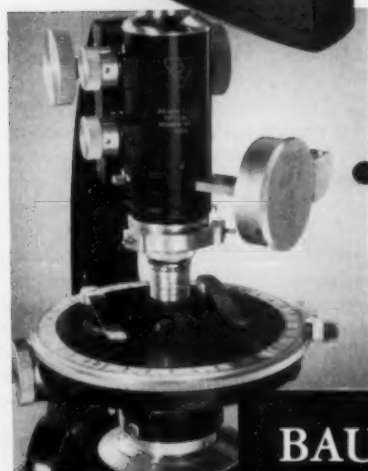
Ewell's method consisted essentially of estimating the portion of the gross national product of the year 1953 that we would not have had without the research and development activities of the preceding 25 years, estimating the total research and development costs of those 25 years, and computing the percentage return. He also pointed out some interesting facts about the growth of research and development expenditures in the United States. Growth has been exponential; from 1776 to 1954 we spent close to \$40 billion, and half of that was spent after 1948. Research and development expenses are increasing at a rate of 10 percent per year and have grown from 0.1 percent of gross national product in 1920 to 1.1 percent in 1955. If growth continues at this rate, the total is likely to fall between \$5.1 and \$5.4 billion in 1960 and between \$6.3 and \$6.9 billion in 1965.

Elementary caution tells one that the quotient of a problem in division can be thrown badly off by an error in either the divisor or the dividend. Ewell had to estimate past research and development expenditures, the total return from research and development, and the portion of that return to credit to research and development as distinct from the capital investment and other expenses necessary to produce and market new or improved products. He also had to decide what types of scientific costs to include; for example, he did not include the cost of educating the scientists and engineers engaged in research and development, or the cost of maintaining the colleges and universities that provide fundamental nourishment to the country's whole scientific effort. These estimates can be made most accurately for industrial developments. In contrast, what a guessing game it would be to try to estimate society's returns from the insignificant cost of the research of Maxwell, Faraday, and the other pioneers in electricity.

Despite its margin of uncertainty, Ewell's analysis of the economics of research provides a fascinating basis for speculating over the future of research management and policy. Speculation in a lighter vein is also provoked. A broker, apparently assuming we have money to invest, has recently been favoring us with persuasively written descriptions of the future prospects of a number of common stocks. Imagine the prospectus that could be written on the basis of Ewell's calculations if *Research and Development Unlimited* was listed on the New York Stock Exchange.—D.W.

# MORE MICROSCOPE

## for your money



### EASIEST FOCUSING EVER!

Entire focusing system "floats" on ball bearings and rollers; no drift, bind, or backlash. Ultra-fine focus, with 1 micron divisions, assures immediate critical focus at all magnifications.

### LIFETIME ACCURACY!

Ball bearing nosepiece, self-compensating for wear, provides identical repeat settings. Ball bearing stage, factory-precentered, graduated in single degrees, drilled and tapped to receive mechanical stage. Choice of pre-set or rotatable polaroid polarizer, both with iris diaphragm. (Centerable nosepiece available for research.)

### BRIGHT, EASY-TO-SEE IMAGES!

Entire optical system is dustproof, including flip-in polaroid analyzer and accessory slot. Strain-free achromatic objectives. Uniform light on full field. Opti-lume Illuminator (optional), interchangeable with mirror, is ventilated to assure cool stage necessary for Becke Line Tests.

### ● NEW! B&L ACCESSORY SLOT COMPENSATOR SPEEDS BIREFRINGENCE MEASUREMENTS

This important quality control and research aid quickly and efficiently measures phase difference; speeds determination of optical character or sign. Direct-reading magnified scale, calibrated in millimicrons; no computation or conversion needed. Readings correct to  $\pm 2\%$  over a range of 0 to 2700 millimicrons. Fits all American microscopes of current design.

## BAUSCH & LOMB



### WRITE FOR DATA AND DEMONSTRATION

Catalog D-130, and obligation-free demonstration, yours on request. Bausch & Lomb Optical Co., 64275 St. Paul St., Rochester 2, New York.

America's only complete optical source... from glass to finished product.

## Recent Geology of Cane Wash, Monument Valley, Arizona

Charles B. Hunt

Among the major problems in the Colorado River drainage basin are soil erosion, arroyo cutting, and sediment load of the streams. In order to appraise in quantitative terms the effects of these several processes as they are operating today and have operated since about 1880, when most of the present arroyo cutting began (1), it is necessary to reconstruct the late Pleistocene and Recent history of the region. If this history were understood, it would be possible to evaluate the changes that have occurred in climate, vegetative cover, water supply, prehistoric land use, and other environmental conditions and appraise these changes as factors that must be considered in attempts to meet the present-day problems.

Natural history, like political and economic history, repeats itself. The arroyo cutting, dune migration, gully development on hillsides, other soil erosion, and the sediment-loaded streams that characterize the Colorado Plateau have occurred repeatedly during the Recent epoch. In order to estimate intelligently the damage done by erosion that has occurred since 1880 and the damage being done today, it is necessary to separate the effects of each of the different periods of erosion. An easily made mistake would be to attribute all the arroyo cutting to erosion since 1880; actually, many of the arroyos were well formed prior to 1880 and have merely been overdeepened or widened by the present-day cutting (Fig. 1). Another easily made mistake would be to overestimate the degree of present-day wind erosion; most of the loose sand that forms the present-day active dunes

is being reworked from ancient dunes that originally formed during the very dry period or periods at the beginning of the Recent.

We cannot hope to map and study the late Pleistocene and Recent deposits of an entire river basin in time to solve the problems we face today, but a number of representative areas could be studied in order to measure the volumes of materials involved during each of the alternating periods of erosion and deposition. If we knew how much material was involved in the present and past periods of erosion, we could reasonably hope for better understanding of the processes involved.

Cane Wash, in Monument Valley in northeastern Arizona (Fig. 2), is one of the localities that promises to yield much useful information when the opportunity arises to study the valley in detail. This report, based on about a week of reconnaissance observations during May 1951, attempts only to present the possible bearing of Recent history on these problems of erosion and sedimentation.

### Summary of Recent History

Pleistocene time in the Navajo country closed with deposition of an extensive alluvial deposit bearing mammoth remains and known as the Jeddito formation (2, p. 60). The climate evidently was cool and moist compared with that of the present.

The early part of the Recent was a time of great aridity, commonly referred to as the thermal maximum, the climatic optimum, or alithermal. During this time there was extensive erosion on the Colorado Plateau; the arroyos that were

formed in general were deeper and wider than those formed in subsequent periods of aridity. Thick and extensive sand dunes also were formed at this time.

Moister conditions seem to have prevailed during the first and second millennia B.C. and during the earliest centuries of the Christian era. At this time alluvium, the Tsegi formation of Hack (2, p. 62), was deposited in the Navajo country. While the valleys were being aggraded, they were occupied by a prepottery people whose stone tools and hearths are common in the alluvium (3, p. 21).

During the Christian era especially severe drouths, lasting two or three decades, occurred near A.D. 715, 1100, 1290 and 1585 (4, p. 214). The latter part of the 19th century seems to have been another such period of drouth.

At the end of the 13th century, during the dry period known as the Great Drouth, the Anasazi people, who had built homes and had irrigated farms on the Tsegi alluvium, moved away from the Navajo country. Sometime between A.D. 1300 and 1700 another alluvial deposit formed in the Navajo country; Hack (2, pp. 62, 67) has referred to it as the Naha formation. The present arroyo cutting began in the last two decades of the 19th century (1).

### Setting of Cane Wash

Cane Wash (Fig. 2) drains northeastward in a treeless valley cut in Triassic formations lying along the north base of Comb Ridge, which is a hogback formed by the Glen Canyon group of sandstones (Triassic and Jurassic) (5). In the vicinity of Chaistla Butte, and for about 3½ miles to the east, Cane Wash is in an arroyo 12 to 15 feet deep cut in an alluvial deposit that apparently is prepottery and no younger than the Tsegi formation. About 3½ miles east of Chaistla Butte the wash emerges from its arroyo and from there east is on top of the alluvium and is aggrading the valley floor. About 9 miles east of the butte the drainage enters an old, dried lake bed, which evidently formed as a result of the valley being dammed by some ancient dunes that lie north and east of the lake.

There is no perennial surface water along the present Cane Wash. There are, however, extensive ruins of prehistoric Anasazi villages along the Wash, and

Mr. Hunt is on the staff of the U.S. Geological Survey, Federal Center, Denver, Colo.

evidently there was surface water available at the time of occupation (roughly A.D. 500-1200).

### Stratigraphy of the Recent Deposits

The oldest deposits recognized antedate the Anasazi occupation and are of three kinds: alluvial fans, sand dunes, and alluvium. Also recognized are post-occupation eolian sand, alluvium, and lake beds.

The alluvial fan deposits (fg) shown in Fig. 2 are along the north base of Comb Ridge and slope to the alluvial valley bottom. It may be that the fan deposits are very thin and mantle pediments. Presumably they intertongue with the alluvium ( $al_1$ ) to the north, but this possible relationship was not established. In any case, this ground is stony and slopes toward Cane Wash. The surfaces of the fans seem to be fairly stable; no conspicuous signs of degradation or aggradation were observed.

Preoccupation sand dunes ( $s_1$ ) are widespread along the north side of Cane Wash. The dunes are clustered barchans 10 to 15 feet high. Today they are being reworked actively by wind action. The unconformity between this reworked sand and the older sand from which it was derived is the Anasazi occupation layer. Abundant remains of vegetation along this layer include juniper and shrubs that today grow only on the valley walls a few hundred feet higher than these dunes. The older sand is pre-Anasazi in age and probably dates from the thermal maximum at the beginning of the Recent.

Postoccupation alluvium, probably Tsegi ( $al_1$ ), is at least 15 feet thick along Cane Wash for about  $3\frac{1}{2}$  miles east of

Chaistla Butte. This alluvium presumably extends beneath the younger alluvium ( $al_2$ ) to the east and beneath the younger sand ( $s_2$ ) to the north. It may intertongue with, or overlap onto, the fan deposits along the south side of the wash. The stratigraphic relationship between this alluvium and the preoccupation sand dunes has not been determined, but the ages inferred for the two deposits imply that the alluvium overlaps the older sand ( $s_1$ ).

Cane Wash is incised as deeply as 15 feet into the alluvium. Tributary to the main arroyo are deep gullies. Between these gullies and northward for several hundred feet from the main arroyo, the alluvial surface has been lowered by deflation as much as 2 feet since the Anasazi occupation. The deposit, therefore, is being eroded actively by Cane Wash and its tributaries, and the surface of the deposit is being eroded by wind action.

The postoccupation eolian sand ( $s_2$ ) is extensive but rarely deep. It occurs as a thin hummocky sheet on the preoccupation alluvium north of sites A, and this deposit apparently was derived largely from deflation of the alluvial surface along the wash. It is present also in the area of older sand dunes north of the segment of valley that is being aggraded (between the two groups of sites B). In these areas active dunes are 10 to 15 feet high.

Postoccupation alluvium ( $al_2$ ) forms an inner fill terrace 5 or 6 feet high within the arroyo of Cane Wash. This deposit is too small to show on the map. East of the arroyo of Cane Wash, however, this postoccupation alluvium covers the flood plain and the eastern part of the preoccupation alluvium.

The lake beds at the eastern edge of

the area no doubt include deposits as old as the preoccupation dunes that dammed the wash, but the surface layers are post-occupation in age.

### Probable Environment of the Ruins at the Time of Occupation

The Anasazi occupation is represented by the ruins of numerous one-room dwellings, foundations of ovens or cists, and a scattering of potsherds and stonework. The ruins can be described in three groups, designated in Fig. 2 as sites A, B, and C. A surface sample of sherds and stonework from each of the groups was collected, and tentative identifications were made by Arnold Withers, of the University of Denver, and by Frank H. H. Roberts, of the Bureau of American Ethnology. The collection, which has been deposited in the Bureau of American Ethnology, includes types of materials characteristic of the Basketmaker III through Pueblo III cultures, and the occupation, therefore, may be dated roughly as A.D. 500 to 1200 or 1300. The collection also suggests that the eastern sites contain a higher proportion of materials from the earlier cultures than do the western sites. To confirm this impression would require studies by archeologists, but it might be an important fact bearing on attempts to evaluate erosion and sedimentation if the center of population actually did shift upstream during the period of occupation.

All the ruins obviously represent open valley sites. The sites designated C are on old dunes surrounding the lake bed at the eastern edge of the area. Only two sites were observed here, but presumably others are concealed by the young sand that has been derived by reworking the old dunes. According to a letter from Roberts "... the material from sites C appears to be pretty much straight Pueblo I. There are one or two sherds that might be considered Basketmaker III, but the bottoms of the culinary vessels from Pueblo I frequently are hard to distinguish from some of the Basketmaker III fragments. Certainly the over-all impression given by the lot of sherds is a straight Pueblo I horizon."

Abundant tree stumps and logs were observed among the dunes in the vicinity of sites C, at the unconformity represented by the occupation zone. Apparently this part of the valley was woodland at the time of occupation. Some of the buried trees are cottonwood, others are juniper and piñon. It seems likely that the now dry lake bed contained water at least part of the time during the period of occupation.

Upstream from the lake beds (Fig. 2) Cane Wash for about  $3\frac{1}{2}$  miles east of Along this stretch of valley the ruins

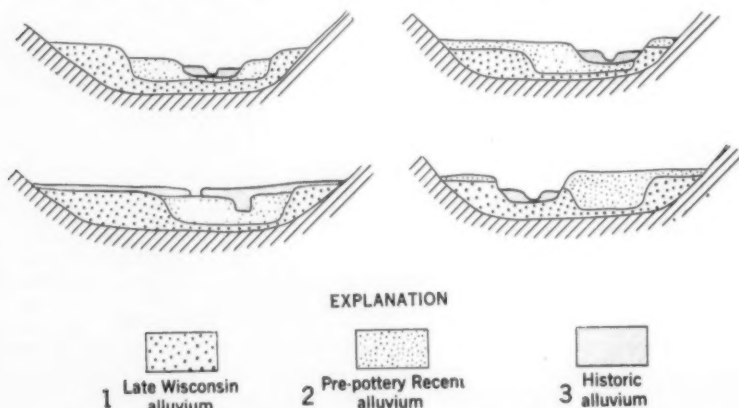


Fig. 1. Diagrammatic sections illustrating some common stratigraphic relationships in the alluvial deposits on the Colorado Plateau. A cross section of Cane Wash at sites A (Fig. 2) might look like the top right section. At the most westerly of sites B the cross section would resemble the bottom left section. In general in the Southwest the width and depth of the modern arroyos are less than the width and depth of the arroyos that were eroded after deposition of alluvium No. 2. And those arroyos generally are not as wide or deep as the arroyos cut in the late Wisconsin alluvium.



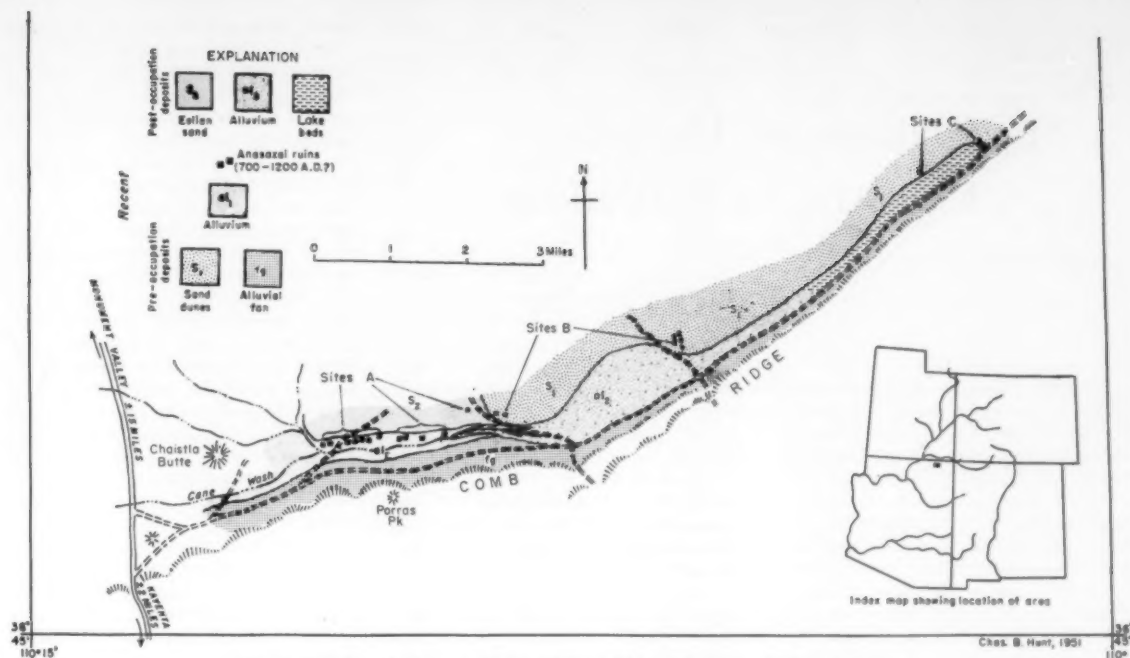


Fig. 2. Sketch geologic map of part of Cane Wash, Monument Valley, Arizona.

(sites *B*) are on the ancient dunes, which are higher than the valley floor. The ruins at *B* appear to be younger than those at *C*. The pottery collection from *B* was reported on by Roberts (in a personal letter) as follows.

"The material from sites *B* suggests about equal representation for Basketmaker III and Pueblo I, and in addition there are a few sherds that probably are Pueblo III, or possibly Pueblo II. I am wondering whether the proportions of Basketmaker III and Pueblo I would be approximately the same from both of the sites *B* or whether perhaps separate collections from the two might not show that a different relationship existed. By mixing the material from the two, the picture may be somewhat clouded. Because the material from sites *C* seems to be straight Pueblo I, I would be inclined to suspect that possibly the eastern *B* might be predominantly Pueblo I."

The valley in the vicinity of sites *B* no doubt was subject to flooding at the time of occupation, much as it is today. While this stretch of valley is being aggraded, winds transport sand from it to the north. The occurrence of preoccupation sand dunes immediately north of this stretch of the valley suggests that the regimen of this stretch is rather like it was prior to deposition of the preoccupation alluvium.

The sites at *A* are on the alluvium north of Cane Wash, and very likely

others are buried beneath the younger sands ( $s_2$ ) to the north. The collection from these sites indicates they are younger than those at *B*. Roberts reported on the collection as follows.

"The specimens from sites *A* indicate a predominant Pueblo III horizon. A few sherds are of older types, but the proportion is very small. I am not certain how the dendrochronological dates run in that area, but I would be inclined to guess that sites *A* probably fall in the A.D. 1100-1200 period. I would be surprised if they are as late as 1300."

No sites were observed on the fans or alluvium south of the wash. The occurrence of dwellings on the alluvial plain and their alinement along the north side of the present wash strongly suggest that the stream was at the same location then as now, that its bed was below the level of the alluvial surface, and that it discharged sufficient water to supply a considerable population. Moreover, in places the surface of the alluvium is marked by linear or curvilinear furrows that may be remnants of ancient irrigation works.

In any case, the evidence at hand suggests that the earliest Anasazi occupation was at the east end of the area shown on Fig. 2, and that the center of population shifted upstream during the period A.D. 500-1200. Such a shift in population could be interpreted, in part at least, as response to diminishing discharge in Cane Wash.

## Conclusions

In numerous areas like Cane Wash there is need for detailed geologic mapping of the late Pleistocene and Recent deposits to determine the geologic stratigraphy and the successive changes in the physical geography and regimen of the valley and to measure the volumes of materials involved in the different kinds and different stages of erosion and sedimentation. Also there is need for studies by archeologists to provide the basis for determining the dates of occupation, estimating the population, and determining whether there were significant shifts in centers of population during the occupation periods. Further, these studies should be supplemented by studies of the botanical and ecological changes that have occurred. If such basic information from the historical and prehistorical record were available, we would be ever so much better prepared to deal with today's land-use problems in which erosion, sedimentation, and water supply are important factors.

## References

1. K. Bryan, *Science* 62, 338 (1925).
2. J. T. Hack, *Papers of Peabody Mus., Arch. and Ethn., Harvard Univ.* 33, No. 1 (1942).
3. A. P. Hunt, *Univ. of Utah Anthropol. Papers*, No. 14 (1953).
4. E. Schulman, *Bull. Am. Meteorological Soc.* 19, 211 (1938).
5. I. Witkind, in preparation.

# Speculations on Hazards of Exposure to Radiations

John Keosian

Recently attention has again been called to the serious danger of increasing the amount of deleterious mutations in the human gene-pool in the face of increasing background radiation caused by atomic energy experiments (1, 2), once more highlighting the existence of long-range hazards as against immediate hazards of exposure to high-energy radiations. The result of this effect on future generations 100 years, and more so 1000 years, from now would appear to be disturbingly great. Basing the conclusions on the knowledge of genetics, evolution, and biological phenomena in general, the picture is not exaggerated; if anything, it is conservative. There are several aspects, however, that have received less attention and possibly can alter the picture.

One of these aspects relates to the effect of increased background radiation on the process of evolution (3). The resulting increase in deleterious mutations is viewed as a threat to the forward progress of human evolution. An increase in radiation that causes an increase in the rate of mutation would certainly seem to result in an acceleration of evolution, whether it is an eventual genetic deterioration, extinction, or betterment of the species. It is this point about which there may be a question. Would increased radiation lead to genetic betterment? The answer to this question would appear to be in the affirmative. Negative conclusions are based on the following assumptions. (i) The harmful effects of deleterious genes are additive in a simple way. (ii) There is a critical mutation load (a sum-total of existing deleterious genes in a population) that cannot be exceeded without threatening the species with extinction. (iii) The species is at, or is close to, optimal genetic adjustment to its environment. (iv) Laboratory experiments that appear to give an affirmative answer to the question cannot correctly

be applied to the results to be expected in the wild state.

The harmful effects of deleterious genes are not always additive. Two different genes that are separately deleterious may be beneficial when they are present together in the same individual. The very concept of deleteriousness being additive in a simple way is subject to question (4). Certain deleterious recessives are not harmful in the heterozygous state, while others endow the heterozygote with slight or greater advantages over the wild type (5). This is a condition that may be more prevalent than is recognized. The same gene may or may not be deleterious, depending on the genome in which it appears (5). On a long-term basis, the back-mutation rate and the mutation to the nondeleteriousness of a harmful gene must also be considered. Then, too, the environment in which the gene is to express itself must be taken into account (6). A deleterious gene can possibly be neutral or even beneficial in changed environmental conditions, a factor that certainly must be reckoned with when considering long-range effects.

The validity of the concept of a critical mutation load remains to be established for man. It cannot reasonably be argued that man is at or near optimal genetic adjustment to his environment, mentally or physically. That is, he is not close to an evolutionary blind alley, and much room exists for further progress. Under these conditions, increased genetic variability can lead to an accelerated evolution along beneficial lines. Laboratory experiments in which populations of *Drosophila* were subjected to high radiation doses and then permitted to breed freely bear on this point (6, 7). After many generations a slight but significant improvement occurred "... in adaptive value arising through the action of selection on either induced or spontaneous mutations," whereas there was indication of "a decreased adaptive value resulting from chronic irradiation." The latter quotation refers to experiments in which populations of flies were irradiated gen-

eration after generation with  $\gamma$ -radiation as high as 2000 roentgens per generation. The nonapplicability of the results of these experiments to man cannot be argued on the ground that the flies, nicely adjusted to the natural environment, were put under artificial conditions to which they made further and rapid adjustment that is not possible in the natural environment. On the contrary, it would seem to have great applicability to the human being. The question of advisability is another matter, since the cost in decreased viability on chronic irradiation is not to be advocated for man. One cannot, in all good conscience, accept such a toll for the sake of results that would take place more slowly at a lesser price. The issue at hand, however, is not a moral one but a scientific one. Would an increase in radiation speed up evolution along beneficial lines in the human being?

This reasoning assumes the normal operation of natural selection. It can be argued that man interferes with natural selection by contributing to the survival of deleterious phenotypes through his scientific and medical knowledge. But increasingly more, his capacity in this direction rests on his ability to diminish or nullify the effect of the harmful gene, in which case the gene in question is no longer actually deleterious but merely potentially so. It is true that such measures have the effect of greatly increasing the number of carriers of the potentially harmful gene, but this would not affect the forward progress of evolution as long as means are available for the neutralization or control of the effects of the gene.

Calculations on the extent of harmful effects in the remote future of an increase in the percentage of deleterious recessive mutants ignore the great strides that biochemical genetics will probably take in the not too distant future. It is not improbable that we shall eventually know the chemical composition and physical structure of the hereditary material; the step-by-step metabolism under its control in the production of the phenotype; and how to control the replication of the gene. To a limited extent the first two of these are already known. The third—the control of the replication of the gene—is not only not possible today, but there are those who even despair of its ever being possible. This undue pessimism stems in part from the belief in the fateful finality of hereditary phenomena and from the conviction that the mutation process, because of its apparently random spontaneous nature, is beyond influence from the environment and, therefore, beyond experimental direction. A case can be made for viewing mutation rates as the orderly out-

Dr. Keosian is professor of biology at Rutgers University, Newark, New Jersey, and experimental biologist in the Department of Laboratories, Newark Beth Israel Hospital.



come of complex biochemical events in an internal environment that adjusts in order to remain stabilized in spite of naturally or experimentally fluctuating external environmental conditions. A more subtle approach than our present attempts must be made to reach and control these events without killing the cell or organism. It is not too much to hope that success along these lines will come sooner than the 100 or 1000 years hence when, it is said, the human race will reap, in lesser or greater measure, the results of our present-day ignorance and shortsightedness. Such success will make it possible not only to ameliorate the effects of deleterious mutations but also to direct mutations back to wild type or to the production of even more advantageous phenotypes. Exploration of the implications of such knowledge is not the burden of this paper.

The greatest cause for alarm, however, is not the magnitude of the responsibility that we face for the fate of future generations. If the human race survives its present crisis it will stand an excellent chance of forestalling or even reversing what harm, if any, we may have visited upon the future. The greatest reason for concern is the damage we may be doing

to the present generations, young and old. The question of maximum tolerance dose of radiation for man has not been satisfactorily determined. There has been a downward revision of this value over the years (8), and it may well turn out that the value is zero; that there is "no clearly safe dosage—all high energy radiation, even of low intensity and brief duration must be considered as potentially dangerous to the exposed individual" (9). This would not be unexpected if radiation is a "monkey-wrench" in the biochemical "works" rather than a causative agent of orderly processes. The evidence also appears to support the view that the effects of radiation damage are cumulative (2). At a time when we are facing an era of expanding use of atomic energy we can ill afford to pile up cumulative harmful effects. Moreover, the survival of individuals accidentally subjected to a high radiation dose (an event of increasing probability) will depend, among other things, on the magnitude of the existing cumulative effects.

In many ways, the greatest danger from poorly controlled and unnecessary sources of radiation—experimental, diagnostic or therapeutic—is to the present living generations. The lack of sufficient

knowledge of the forces unleashed, the manner of their control, the safe and adequate disposal of increasingly large amounts of radioactive waste, and the methods of counteracting the harmful effects on the organism, these and many other associated problems, as yet unsolved, all should give pause to a headlong rush into any activity that has a tendency to increase the amount of radiation to which any individual is exposed. It is a matter that concerns all of us and hence all of us should be concerned about it.

#### References

1. H. J. Muller, *Am. J. Obstet. Gynecol.* 67, 467 (1954).
2. A. H. Sturtevant, *Eng. and Sci.* 18, No. 4, 9 (1955).
3. H. J. Muller, *Am. J. Human Genet.* 2, 111 (1950); H. J. Muller, in *Radiation Biology*, A. Hollaender, Ed. (McGraw-Hill, New York, 1954), vol. 1, pt. 1, p. 432.
4. T. Dobzhansky and B. Wallace, *Am. J. Human Genet.* 6, 199 (1954); A. R. Cordeiro and T. Dobzhansky, *Am. Naturalist* 88, 75 (1954); B. Wallace and C. Madden, *Genetics* 38, 456 (1953).
5. B. Wallace *et al.*, *Genetics* 38, 272 (1953).
6. B. Wallace and J. C. King, *Am. Naturalist* 85, 209 (1951).
7. B. Wallace, *Genetics* 36, 612 (1951); —, *Evolution* 6, 333 (1952).
8. H. H. Plough, *Nucleonics* 10, No. 8, 16 (1952); R. S. Stone, *Radiology* 56, 639 (1952).
9. A. H. Sturtevant, *Science* 120, 405 (1954).

## Oscar Orias, Physiologist

Oscar Orias, one of the leading physiologists of South America and well known to many in the universities of the United States, died suddenly 4 June at the age of 49. His early training was with B. A. Houssay of Buenos Aires; later he studied with Carl J. Wiggers of Western Reserve University and Walter B. Cannon of Harvard University.

After graduation from the School of Medicine of the University of Buenos Aires in 1928, Orias began his scientific career by publishing papers on hemoglobin content of blood of Argentinian men. In 1939 in collaboration with E. Braun-Menendez, he published a mono-

graph *Heart Sounds in Normal and Pathological Conditions*, which has become a classic in the field. *Cytology of Human Vagina* by L. C. de Allende and Orias, the section on circulation in the textbook *Human Physiology* by B. A. Houssay and associates, and a monograph on *Excitability of the Heart* by Brooks, Hoffman, Suckling, and Orias (to be published in 1955) are among his contributions. He worked in many fields, and his publications revealed his high quality as an investigator.

Orias had outstanding ability as a teacher. In 1935 he was appointed professor of physiology of the Medical

School of the University of Córdoba. In 1943 he was dismissed from this chair because he signed a manifesto asking for effective democratic action and American solidarity. For a brief period he again held the professorship at Córdoba but resigned in 1946 following dismissal of Houssay from the University of Buenos Aires. His courageous actions stand as a monument to the spirit of freedom.

In 1947 Orias became director of the Instituto de Investigación Médica-Mercedes y Martín Ferreyra, a post that he held until his untimely death. The trustees of this institute released him to serve as visiting professor of physiology at the State University of New York, College of Medicine at New York City on two occasions. Thus Orias made contributions to medical education in his own country and in the United States. Those who were fortunate enough to have met him will remember his clarity of perception, his gentle sense of humor, his courtesy, and his great desire to be of service to his fellow-men.

CHANDLER MCC. BROOKS  
State University of New York  
College of Medicine at New York City

*The word 'impossible' is not in my dictionary.*—RÖNTGEN.

## News of Science

### U.S. Geological Survey, 1956

The Department of the Interior Appropriation Act for fiscal year 1956 has provided the Geological Survey with \$26.35 million for conducting its activities in geology, topographic mapping, water resources investigations, and the supervision of mineral leasing. During the year many new projects will be initiated in each of the four operating divisions. Funds have also been provided with which to draw up plans and specifications for a new headquarters building to consolidate Survey activities in the Washington area that are now scattered at 16 different locations. It is expected that the new building will be constructed by private industry for Government use on a "lease-purchase" basis.

The major effort of the Geologic Division in 1956 will be directed toward new geologic mapping and investigations of both potential and producing mineral and mineral-fuels areas and toward the development of new methods and equipment needed to search for additional sources of mineral raw materials. A new cooperative program is planned with the State of Connecticut. It will complete the geologic mapping of that state on 7½-minute quadrangles. Cooperative projects already underway in several states will continue. In Nevada, the existing cooperative geologic mapping program is being expanded; and in Puerto Rico operations are being enlarged in order to complete the geologic mapping of the island in approximately 5 years. Survey geologists are also cooperating with the Arizona Bureau of Mines in a plan to revise that state's geologic map. Preliminary work on this project was started by the state in 1954. Other new investigations to be undertaken by the Geologic Division include studies of coking coal in New Mexico, bituminous coal in Pennsylvania, clay in Kentucky, and iron in Wisconsin.

In Pakistan, Thailand, and Indonesia the survey is establishing geologic field parties to plan a program of mapping in mineral areas. This work will be under the auspices of the International Cooperation Administration. Similar projects will continue in the Far East, the Near East, Africa, and Latin America. In ad-

dition, representatives of the Geological Survey will act as advisers to local geological surveys and government officials and assist in mapping programs.

Operations of the Conservation Division in mineral land classification, oil and gas leasing, water and power investigations, and mining leases are steadily increasing; the rising work load trend is expected to continue for many years.

In the Water Resources Division \$7.15 million was appropriated for technical investigations. Of this amount \$4.35 million is earmarked to match state offerings. Under this appropriation the largest cooperative water-resources program in the history of the survey will be in progress. The current drought over wide areas of the West and Southwest and the need for larger water supplies to meet expanding use in many areas are cited as major reasons for increased interest by the states in the federal program.

Congress appropriated \$11.32 million for the Topographic Division in fiscal year 1956. This amount includes \$1.02 million that is to be used for matching funds that the various states and local governments are expected to appropriate as their voluntary contribution to speed up mapping projects in which they have a special interest. In such programs the state and local governments contribute half the cost, including costs for personnel and equipment. Twenty-eight states have indicated their desire for this type of cooperation this year.

State mapping advisory committees have been organized by 17 states to study the mapping needs within their borders in order to submit coordinated expressions of map requirements to assist the survey in its program. A probable long-range saving of about 25 percent in the cost of preparing map manuscripts for printing is expected from the new technique of scribing or "engraving" map data on special, film-coated negatives, instead of working with pen and ink on paper. New techniques, special instruments, and precise optical equipment developed by survey engineers over the years have resulted in a steady increase in the amount of mapping that can be turned out each month without substantial increase in personnel. More than 1,500 new or revised quadrangles, cover-

ing about 140,000 square miles of United States territory, will be produced in the current fiscal year. Distribution figures indicate that the public will buy approximately 3.5 million maps during the 12-month period, a continuation of the rapid increase in map use that has taken place in recent years.

Complete mapping of the Brooks Range area in Alaska is involved in the new series of 1:250,000-scale territorial maps being prepared to replace the provisional series. This new series is scheduled for completion about 1962.

### News Briefs

■ Joseph Kaplan, chairman of the U.S. National Committee for the International Geophysical Year (USNC-IGY) and former chairman of the department of physics at the University of California at Los Angeles, has announced that the secretariat of the committee now includes the following: executive secretary, Hugh Odishaw, former assistant to the director of the National Bureau of Standards; administrative officer, R. C. Peavey, formerly administrative head of the NBS Central Radio Propagation Laboratory; and program officer, G. F. Schilling, since 1949 a member of the Institute of Geophysics at the University of California, Los Angeles.

The United States program for the IGY, 1957-58, includes the following fields: aurora and airglow, cosmic rays, geomagnetism, glaciology, gravity measurements, ionospheric physics, latitude and longitude, meteorology, oceanography, seismology, solar activity, rocket exploration of the upper atmosphere, and the earth satellite program [Science 122, 322 (19 Aug. 1955)].

The planning for this country's program by the U.S. National Committee has been achieved through the assistance of 14 technical subcommittees and panels. These groups have worked closely with the USNC Secretariat and with many public and private institutions that are cooperating in the US-IGY effort. The U.S. National Committee for the IGY, established by the National Academy of Sciences, is responsible for the formulation, direction, and execution of the U.S. program. Federal sponsorship and funds have been obtained through the National Science Foundation. To date, the Congress has appropriated \$12 million for this country's participation in the IGY.

■ Great Britain will stage the third of a series of atomic weapons tests in Australia next April. Under the direction of C. A. Adams, chief of research at the atomic weapons research establishment at Aldermaston, the tests will be held in

the Monte Bello Islands, where the first British tests were conducted in 1952.

Later next year a fourth series will take place at the atomic weapons proving ground that is being built at Maralinga, in the central Australian desert north of Watson, on the transcontinental railway. This fourth series will be directed by William Penney.

■ K. B. Fraser of the University of Aberdeen has apparently obtained genetic recombination between two strains of influenza A virus when both are inoculated into the same mouse brain. In the 30 July issue of *Nature* Fraser reports that after such double inoculations the neurotropic virus M and the non-neurotropic virus NWS yielded both of the reciprocal types of recombinant, namely NM and WS. The latter was recoverable slightly earlier than the former, which was recovered 12 hours after the inoculation.—B.G.

■ Plans for relocating the recently formed Air Force Office of Scientific Research from Headquarters, Air Research and Development Command in Baltimore, Md., to the Washington, D.C., area have been postponed [*Science* 122, 235 (5 Aug. 1955)]. Lack of suitable space in Washington was given as the reason for the postponement.

■ Improved resolution with the x-ray shadow projection microscope has been obtained by W. C. Nixon, Cavendish Laboratory, Cambridge, England [*Nature* 175, 1078 (18 June 1955)]. Former shadow-type x-ray microscopes have been limited to a resolution of 0.5 microns, mainly because of electron scattering in the metal target. To reduce this, x-ray targets of beaten gold leaf 0.1 micron thick were stretched over an opening of 100 microns, making it possible to reach a resolution of 0.1 micron (1000 Å). The target supports atmospheric pressure and is not broken by high electron current densities if the focal spot is less than 1 micron in diameter.

With this improved resolution, Fresnel edge diffraction fringes of 0.1 micron can be seen when the specimen and photographic plate are correctly placed. The article is illustrated with reproductions of 1500 mesh-per-inch test grids at magnifications of 3600 and 2000. These indicate the resolution of the instrument with 10-kilovolt electrons (exposure time about 5 minutes).

The author suggests that reducing the thickness of the gold leaf and using voltages in the 2- to 5-kilovolt region will reduce electron penetration, increase contrast, and might make the unexplored region beyond the ultraviolet microscope accessible with a specimen at atmospheric pressure.

■ The Republic of Korea's first hydroponic farm—a farm where plants are grown in chemicals, water, and gravel rather than in soil—was officially opened on 30 Aug. in a ceremony held at Suwon. The hydroponic unit was established by the United Nations Korean Reconstruction Agency (UNKRA) with the assistance of the American-Korean Foundation. It will be owned and operated by the Central Agricultural Experiment Station, under the ROK Ministry of Agriculture, and will be used for research and training by both the experimental station and by the College of Agriculture of Seoul National University.

The 1-acre farm consists of 52 concrete beds in which vegetables are planted in gravel, and four concrete tanks containing water and chemicals. Periodically the chemical-bearing water is circulated to the plants by means of four electrically driven pumps. The system makes it possible for the amount and kinds of plant food to be controlled exactly, and the use of four tanks permits experimentation with different chemical mixtures.

The hydroponic unit is intended to serve as a research tool to study the needs of different kinds of vegetables for chemical foods and to seek ways of increasing crop yields, as a laboratory for use in the teaching of soil science to agricultural students, and as a pilot plant to show whether more extensive use of hydroponic farming might be beneficial in Korea.

## Scientists in the News

HEROLD C. HUNT, professor of education at Harvard University, has been named Under Secretary of Health, Education, and Welfare by President Eisenhower. Hunt succeeds NELSON A. ROCKEFELLER.

CHARLES ALLEN THOMAS, president of the Monsanto Chemical Co., St. Louis, Mo., and a leader in the wartime atomic energy program, received the 1955 Priestley medal, highest honor in American chemistry, during the recent meeting of the American Chemical Society in Minneapolis, Minn. Thomas, a former president and former board chairman of the society, was honored for his "outstanding services to chemistry." His medal address was entitled "Science as a profession and its appeal to youth."

The winners of 13 other awards were announced at the Minneapolis meeting. Presentation will be made during the society's 129th national meeting in Dallas, Tex., next spring.

WILLARD F. LIBBY of the Atomic Energy Commission, inventor of the screen-wall

Geiger counter and the atomic time-clock method of measuring geologic age, has been chosen to receive the \$1000 ACS award for nuclear applications in chemistry. The annual prize is sponsored by the Nuclear Instrument and Chemical Corp. of Chicago, Ill.

HARRY G. DRICKAMER, professor of chemical engineering at the University of Illinois, is the winner of the \$3000 Ipatieff prize, given every 3 years. It is awarded to a scientist under 40 "to recognize outstanding chemical experimental work in the field of catalysis or high pressure."

ALLENE R. JEANES, chemist in the Northern Utilization Research Branch of the Agricultural Research Service, Peoria, Ill., who has contributed importantly to the development of dextran and its use as a blood volume expander, will receive the society's Garvan medal. The gold medal is given annually to recognize "distinguished service to chemistry" by a woman chemist.

SAMUEL R. HOOVER, head of the hides, tanning materials, and leather section in the Philadelphia research laboratory of the Eastern Utilization Research Branch of the Agricultural Research Service, has won the \$1000 Borden award in the chemistry of milk.

PAUL M. DOTY, associate professor of chemistry at Harvard University, has been selected for the \$1000 ACS award in pure chemistry. The award, sponsored by Alpha Chi Sigma, professional chemical fraternity, will honor Doty for his research on biological polymers.

HAROLD W. WASHBURN, vice president and director of research of the Consolidated Engineering Corp., Pasadena, Calif., will receive the \$1000 Beckman award in chemical instrumentation for his internationally recognized contributions to chemical analysis by means of the mass spectrometer. The prize, sponsored by Beckman Instruments, Inc., South Pasadena, Calif., is presented annually to a resident of the United States or Canada.

ROBERT A. ALBERTY, associate professor of physical chemistry at the University of Wisconsin, is to receive the Eli Lilly and Co. award in biological chemistry for his research in the field of enzymes. This annual award consists of \$1000 and a gold medal.

MILBURN J. O'NEAL, JR., group leader in charge of the analytic research group, Shell Oil Co., Houston, Tex., will be presented with the \$1000 Precision Scientific Co. award in petroleum chemistry.

VICTOR K. LA MER of Columbia University won the \$1000 Kendall Co. award in colloid chemistry.

HERMAN PINES of Northwestern University is to receive the Fritzsche award, \$1000 and a gold medal, for achievement in the field of essential oils. The prize

is sponsored by Fritzsche Brothers, Inc., New York.

HARVEY C. DIEHL, professor of chemistry at Iowa State College, is the winner of the Fisher award in analytic chemistry, sponsored by the Fisher Scientific Co. of Pittsburgh, Pa. This award of \$1000 and an etching is given to recognize and encourage outstanding contributions to the science of analytic chemistry in the United States or Canada.

MERTON F. UTTER, associate professor of biochemistry at Western Reserve University, has been chosen to receive the \$1000 Paul-Lewis Laboratories award in enzyme chemistry. The prize was established by Paul-Lewis Laboratories, Inc., Milwaukee, Wis.

OTTO M. SMITH, emeritus professor of chemistry and chemical engineering and director of the Research Foundation at the Oklahoma Agricultural and Mechanical College, will be presented with the \$1000 scientific apparatus makers award in chemical education.

CLARENCE E. LARSON has been appointed vice president in charge of research for the National Carbon Co., a division of the Union Carbide and Carbon Corp. He was formerly director of the Oak Ridge National Laboratory, which is operated by Union Carbide for the Atomic Energy Commission. Larson will head all of the National Carbon Co.'s research activities and will be a member of the corporation's research committee. His headquarters will be in Cleveland, Ohio, at the company's new research laboratory that is now under construction.

L. M. CURRIE, former vice president in charge of research, will continue as vice president and will assume new responsibilities involving sales, production, development, and research.

CHARLES L. DUNHAM has been appointed director of the Atomic Energy Commission's Division of Biology and Medicine, effective 1 Oct. He succeeds JOHN C. BUGHER, who will return to the Rockefeller Foundation, where he was recently named director of medical education and public health. Dunham became deputy director of the Division of Biology and Medicine in July 1954. He is succeeded in this post by CHARLES W. SHILLING, who since July has been serving as a special assistant to Bugher [*Science* 122, 409 (2 Sept. 1955)].

WILLIAM E. REYNOLDS, assistant professor of preventive medicine at the Harvard Medical School since 1949, became head of the department of public health and preventive medicine at the University of Washington in Seattle on 1 Sept. He succeeds Leland Powers, who resigned in 1953 to join the medi-

cal faculty of the American University in Beirut, Lebanon. Reynolds' research interests include rheumatoid arthritis, heart disease, and eye diseases in newborn infants.

R. E. BLACKWELDER delivered this summer's Timothy Hopkins lectures at the Hopkins Marine Station of Stanford University. The series of 10 lectures had the general title "Basic biological concepts." Blackwelder recently resigned from the Smithsonian Institution to pursue studies on the principles of biology.

ROBERT F. MEHL of Carnegie Institute of Technology has been invited to lecture at the Royal School of Mines, University of London, 20-25 Oct. Mehl, who is head of the department of metallurgical engineering and dean of graduate studies at the institute, is the first American to receive a lecture invitation from the British institution since its founding 100 years ago. He will discuss diffusion in solid metals and alloys; formation of ferrite and bainite from austenite; the pearlite-austenite reaction; and the growth of metal crystals from metal vapor.

BENJAMIN PASAMANICK, formerly associate professor in the division of mental hygiene, Johns Hopkins School of Hygiene, has been appointed professor of psychiatry at Ohio State University College of Medicine, and director of research at the Columbus State Psychiatric Institute.

ELLIS R. LIPPINCOTT, associate professor of chemistry at Kansas State College since 1951, has been appointed professor of chemistry at the University of Maryland. Lippincott is an authority on infrared and Raman spectroscopy. Another phase of his work has been concerned with the hydrogen bonds of proteins and biological substances. His principal activity at Maryland will be the development of a satisfactory theory of the nature of chemical bonds.

R. W. LAMONT-HAVERS, for the last year medical director of the British Columbia Division of the Canadian Arthritis and Rheumatism Society, has succeeded GIDEON K. DEFOREST as associate medical director of the Arthritis and Rheumatism Foundation, New York. DeForest will resume his duties on the teaching staff of the Yale University School of Medicine, where he is also head of the arthritis clinic.

OLIVER F. SENN, former assistant chairman of the chemistry department, Stanford Research Institute, has been appointed chairman. Recently he has centered his attention on research in waste utilization and air pollution.

## Necrology

JOHN C. DESSLOCH, Rochester, N.Y., 73, chief anesthesiologist at Genesee Hospital for 25 years and a member of the staff for 41 years, former president of Associated Anesthetists of the United States and Canada, 9 Sept.

GRAHAM EDGAR, Greenwich, Conn., 67, consulting chemist to Ethyl Corp., New York, former professor of chemistry at California Institute of Technology and the University of Virginia, World War I consultant chemist to the Army Ordnance Corps, and former staff member of the National Research Council, 8 Sept.

W. REDETT HATFIELD, White Plains, N.Y., 58, dentist and former assistant professor at Columbia University, 6 Sept.

GERADUS P. HERRICK, New York, N.Y., research engineer, "father of convertible aircraft," World War I captain in the aviation section of the Army Signal Corps, 9 Sept.

GEORGE A. HULETT, Princeton, N.J., 87, emeritus professor of chemistry at Princeton University and first professor of physical chemistry to be appointed there, a founder of the Army Chemical Warfare Service, 6 Sept.

WILLIAM F. JENNINGS, Mendham, N.J., 69, powder metallurgist, 14 Sept.

ALFRED E. MIDGLEY, Linden, N.J., 67, chemist, 8 Sept.

GUSTAVE NOBACK, Forest Hills, N.Y., 65, retired professor of anatomy at Cornell University, former chairman of the department of anatomy at the College of Dentistry, New York University, former professor and head of the department of anatomy at the University of Puerto Rico, 10 Sept.

ROBERT SALTER, Washington, D.C., 63, chief of soils research for the Department of Agriculture and former head of the Soil Conservation Service, former chairman of the Ohio State University's Agronomy Department, vice president in 1938 of AAAS Section O, Agriculture, 14 Sept.

HAAKON STYRI, Philadelphia, Pa., 69, research consultant and metallurgist, 13 Sept.

## Education

■ Development and construction of a new radiotelescope for solar research has recently been announced by Donald H. Menzel, director of Harvard College Observatory. This radiotelescope, technically known as the dynamic spectrum analyzer, will be used to further basic scientific knowledge of the sun by studies of the radio emission from active sunspots and other solar disturbances.

The radiotelescope will consist of an antenna 28 feet in diameter, used in



conjunction with highly sensitive receivers, which scan the frequency range from 100 to 600 megacycles at the rate of 10 times per second. This solar radiotelescope will be the first of its type in the country. The equipment will be placed in operation at the Upper Air Research Observatory at Sacramento Peak, N.M., in the early part of 1956. This observatory, which is a joint scientific operation by Harvard and the Air Force, is now devoted largely to optical observations of the sun with coronagraphs and other specialized optical instruments.

Construction of the new radiotelescope has been made possible through financial support extended by the Geophysical Directorate of the Air Force Cambridge Research Center. Henry Jaski, consulting engineer of Mineola, N.Y., will serve as electronics consultant to the project.

The astronomer-in-charge of the new telescope will be Alan Maxwell, recently of the Jodrell Bank Experimental Station of the University of Manchester, England. He joined the Harvard College Observatory staff in August. Richard N. Thomas, of the observatory staff, will direct the scientific project in conjunction with Menzel.

■ A special advanced course in theoretical problems of microwave physics will be offered by the California Institute of Technology this coming year for the benefit of the institute's Industrial Associates. The new course, which will be conducted by Charles H. Papas, associate professor of electrical engineering, was inspired by the interest of Industrial Associates representatives who attended a series of seminars on antenna theory held at C.I.T. last fall. The institute does not ordinarily offer courses for industry.

■ The University of Maryland issues an unusual periodical, *The Barker*, which is published bimonthly by Arnold W. Kellner, Sr., manager of the animal farm at the university's school of medicine. The 4-page mimeographed newsletter is distributed to the employees of the animal farm, to science teachers in the Baltimore schools, and to interested employees at the university. *The Barker* first appeared in March of this year as a 3-page mimeographed letter. Subsequent issues have been a page larger.

Contents of the publication vary from a long story—continued through two issues—about how Baltimore met the problem of supplying research dogs from the municipal pound, to helpful hints on animal care. The first issue carried an invitation to visit the animal farm daily from 10 A.M. to 4 P.M., without appointment except for large groups.

■ Lehigh University will dedicate its new Fritz Engineering Laboratory on 14 Oct. The building consists of a seven-story section 130 feet by 70 feet and a four-story section 114 feet by 24 feet. The main test bay of the new building measures 50 feet by 130 feet. It houses a 5-million-pound testing machine that is serviced by a 20-ton crane 65 feet overhead.

■ The teaching of psychiatry has been expanded at the University of Oklahoma School of Medicine with the appointment of two more full-time psychiatrists and the opening of the first 20 of 60 neuropsychiatric beds at University Hospitals. Although the neuropsychiatric areas were built 3 years ago, it was not until this year that the legislature appropriated moneys to start operating the inpatient services.

With the opening of the 20 beds in August and the use of 114 affiliated beds at the Oklahoma City VA Hospital, the training of the first four psychiatric residents is under way. The psychiatric outpatient service, which has been in operation for many years, will continue to expand as more beds are opened.

The two new appointees are Donald C. Greaves, who has been attending psychiatrist at the Payne Whitney Clinic in New York, and John Gussen, formerly of the Karoline University Hospital, Stockholm, Sweden. Greaves was appointed associate professor of psychiatry, and Gussen an assistant professor.

■ New York University is erecting a 300-foot weather study tower at Indian Point in Buchanan, N.Y. This tower represents the first step in the construction of an electric generating station by Consolidated Edison. The proposed \$55-million station will use fuel oil, as well as the fission of atoms, to generate electricity.

Consolidated Edison has contracted with the research division of N.Y.U.'s College of Engineering for a 1-year study of local weather conditions. The study will determine the necessary height of the plant's stack to prevent pollution in the vicinity.

■ Cornell University is establishing a biological and conservation station at Shackleton Point on Lake Oneida, N.Y., on a 400-acre estate bequeathed to the university by an alumnus, Charles S. Brown, Syracuse engineer and inventor who died in 1953. Gustav A. Swanson, head of Cornell's conservation department, will be responsible for developing the station, and Edward C. Raney will direct its scientific program.

The area is an exceptionally rich one for work in biology and conservation. Research projects have begun, and plans for summer classes and extension experiments and demonstrations are under

way. Cooperating with the State Conservation Department, the university expects to develop a series of ponds to attract even more wildlife and for pond fisheries studies.

■ Rensselaer Polytechnic Institute and Raytheon Manufacturing Co., Waltham, Mass., have jointly announced the initiation of a cooperative education plan. Under this plan selected electrical engineering students will be given assignments in Raytheon's laboratories and factories so that they may parallel their academic pursuits with actual work in their chosen field. The program will lead to a bachelor's degree.

### Grants, Fellowships, and Awards

■ During the year June 1956 to June 1957 the Office of Naval Research will continue its program in support of basic research in astronomy and astrophysics. As in past years, an advisory committee of seven astronomers nominated by the Council of the American Astronomical Society will aid ONR in evaluating proposals received. At present the membership of this committee is as follows: O. C. Wilson, *chairman*, B. J. Bok, J. W. Evans, G. C. McVittie, A. B. Meinel, J. J. Nassau, and K. Aa. Strand.

Proposals for research to be undertaken should be addressed to the Chief of Naval Research, Department of the Navy, Washington 25, D.C., Attention: Code 430. Ten copies will be required and, if possible, a letter of approval from the institution at which the work will be performed. These should be received not later than 15 Dec.

■ During the coming school year, 140 students throughout the nation will share awards totaling \$10,000 in the 5th annual program of Science Achievement Awards. The program is conducted by the Future Scientists of America of the National Science Teachers Association. The contest is open to all students in grades 7 through 12 in public, private, and parochial schools. Awards consisting of U.S. Savings Bonds, gold pins, certificates, and school trophy plaques will be given for outstanding projects. Honorable mention awards will be granted to several hundred additional students. Equal awards will be given in each of eight geographic regions. The National Association of Secondary-School Principals has placed this contest on the Approved List of National Contests and Activities for 1955-56.

Any project—for example, an investigative problem, library research, model building—in general science, biology, chemistry, physics, or any field of science or mathematics at any grade level (7

through 12) is eligible for entry. Special national awards will be given for projects that deal with metals or metallurgy. Project reports must be mailed to regional chairmen *not later than 15 Mar.*

The Science Achievement Awards program is sponsored by the American Society for Metals. To participate, students are expected simply to complete and report on a science or mathematics project; there are no tests to take and no essays to write. Awards are designed to give recognition for individual student activity and accomplishment and to encourage students to consider careers in science and engineering.

Additional information and student entry forms may be obtained from the Future Scientists of America, National Science Teachers Association, 1201 16 St., N.W., Washington 6, D.C.

■ The National Vitamin Foundation invites individuals who hold doctoral degrees in medicine or one of the biological sciences and who are interested in continuing their training in the science of nutrition to become candidates for the second Russell M. Wilder fellowship. This fellowship was created by the foundation to honor Russell M. Wilder of the emeritus staff of the Mayo Clinic.

The fellowship is for 3 years and pays the recipient \$4500 the first year, \$5000 the second, and \$5500 the third year. It becomes effective on 1 Jan. 1956. Application forms can be obtained from the offices of the National Vitamin Foundation at 15 E. 58 St., New York 22. Candidates must mail their completed application forms to the foundation *before 15 Oct.*

■ The Sears Roebuck Foundation has announced a \$125,000 grant to assist newly practicing physicians. The plan was started by the foundation in cooperation with the American Medical Association as "an investment in individual incentive."

Physicians seeking to establish practices but unable to get full local financing will be offered unsecured 10-year loans up to \$25,000 each. At least one loan in each of five regions across the country will be given this year.

The foundation states that "This is a plan aimed at creating the financial and managerial conditions best designed to satisfy the medical needs of the American people, the professional and economic needs of the American physician, and the principles of free, voluntary and unregulated practice of medicine in which the physician is beholden to no 'boss' other than his professional ethics and his professional competence."

The plan will be self-expanding, with all repayments and contributions going for further grants. Thus, every grant

made will help to establish another medical practice where needed.

Applications for grants will be screened by a medical advisory board, which has been appointed from nominations by the AMA board of trustees. A request for a grant will be considered on the basis of need for assistance, expected use, and effort and thought by the applicant in the understanding and solution of his own problems.

Physician placement offices of state medical societies will play a major role in getting the program started. The foundation has pointed out that the plan is experimental, and that its continuation after 1955 will depend on the reception and support provided by the medical profession.

Applications must be sent to the office of the region in which the proposed medical practice is to be established. They should be addressed to the director, Sears Roebuck Board, at these locations: Pacific Coast region—2650 Olympia Blvd., Los Angeles 54, Calif.; Southwest—1409 South Lamar St., Dallas 2, Tex.; Midwest—8 E. Congress St., Chicago 5; South—675 Ponce de Leon Ave., Atlanta, Ga.; East—4640 Roosevelt Blvd., Philadelphia 32, Pa.

■ Graduate training in preventive medicine and public health will be offered, starting in 1956, to physicians from four Central American countries under a scholarship program sponsored by the United Fruit Co. at the Harvard University School of Public Health. Scientists from Costa Rica, Guatemala, Honduras, and Panama will receive awards that will provide tuition, or tuition plus maintenance and travel expenses, depending on individual needs.

In subsequent years, United Fruit Co. may broaden the scope of the program to include other countries where the firm has operations. The opportunities, in the future, may also be extended to individuals trained in related health disciplines such as nursing and sanitary engineering.

On completion of a year's training, the scholarship fellows will be eligible for one of the following degrees: master of public health, master of science in hygiene, or master of industrial health. In exceptional cases provision may be made to renew the scholarship for a second year of study that leads to the award of either the degree of doctor of public health or doctor of science in hygiene.

Two scholarships are being offered for the first year of the program. Candidates must return completed admission and scholarship applications *by 1 Jan. 1956* to the Harvard School of Public Health, 55 Shattuck St., Boston 15, Mass.

## In the Laboratories

■ The nation's first installation of compatible color television for hospital use will be made by Radio Corporation of America at the Walter Reed Army Medical Center, Washington, D.C. The comprehensive installation will provide complete color television systems for use by the Armed Forces Institute of Pathology, the Walter Reed Army Hospital, and the Army Medical Service Graduate School.

■ The Chicago Apparatus Co., Chicago, Ill., has acquired the A. J. Griner Co. of Kansas City, Mo., and its subsidiary in Wichita, Kans. The two Griner companies will retain their present names.

■ Further expansion of the Atomic Energy Commission's Rocky Flats, Colo., plant by construction of two new buildings and related facilities and by modification of three existing buildings has been announced. The new facilities, modification, and equipment will cost approximately \$13 million. Preparatory work will begin in a short time and completion is scheduled for early 1957. The Dow Chemical Co. of Midland, Mich., operates the Rocky Flats plant for the AEC.

■ The Gulf Oil Corp. has announced plans for a nuclear science laboratory to be located at the company's research center in Harnarville, Pa. Principal unit in the new facility will be a 3-million-volt Van de Graaff particle accelerator. The unit will be installed on approximately 1 Sept. 1956.

■ A human centrifuge for studying acceleration stresses of jet pilots, the second of its kind in Europe (there is one at Farnborough, England) has recently been established at the Karolinska Institutet, Stockholm, Sweden. An account of the centrifuge was published in a recent issue of the *ASEA Journal*, house organ of the Swedish ASEA Co., which designed and built the device.

## Miscellaneous

■ Publication of vol. 1, No. 1, of a new periodical, the *Journal of Electronics*, has been announced by Academic Press, Inc., which will distribute the journal in the United States and Canada. This new English-language journal will serve as a forum for electron physicists, solid state physicists, chemists, and engineers; it will contain accounts of both theoretical and experimental work.

J. Thomson of the Royal Naval Scientific Service will act as editor, and N. F. Mott, a professor and fellow of the Royal Society, will be the consulting



editor. Volume 1 consists of approximately 600 pages that will be released in six parts; the price is \$15.40, and single issues will cost \$2.80. Orders originating in the United States and Canada should be addressed to Academic Press Inc., 125 E. 23 St., New York 10.

■ The first edition of the Scientific Apparatus Makers Association film directory has been released. It lists all free movie and strip films available through SAMA members. The folder reports 14 motion pictures on subjects ranging from optical instruments to basic electronics. Film information is outlined for each picture according to title, film size, running time, description, and source.

As noted, all films should be ordered directly from the SAMA members sponsoring them. Single copies of the SAMA motion picture film directory may be obtained free from the Public Information Committee, Scientific Apparatus Makers Association, 20 N. Wacker Dr., Chicago 6, Ill.

■ The U.S. Civil Service Commission has announced an examination for patent adviser, electronics. Positions are available at the Signal Patent Agency, Fort Monmouth, N.J. Salaries range from \$3670 to \$7570 a year.

No written test will be given. All applicants must have had appropriate education or technical or scientific experience in electrical engineering or physics. In addition, for the higher grade positions, professional experience in patent work in electronics is required. Further information and application forms may be obtained at local post offices or from the U.S. Civil Service Commission, Washington 25, D.C.

■ A monograph just published by the U.S. Public Health Service presents the first of a two-part detailed summary and interpretation of 10 integrated cancer illness studies that were conducted by the National Cancer Institute. The publication is entitled *Morbidity from Cancer in the United States—Variation in Incidence by Age, Sex, Race, Marital Status, and Geography*. The authors are Harold F. Dorn, chief of the Office of Biometry at NIH, and Sidney J. Cutler, a statistician for the National Cancer Institute. It is available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 65 cents a copy.

The work represents a statistical analysis of thousands of cancer cases examined in 10 large population centers that were surveyed in 1937-39 and resurveyed 10 years later. The areas are Atlanta, Birmingham, Dallas, New Orleans, San Francisco, Denver, Chicago, Detroit, Philadelphia, and Pittsburgh.

According to the study, most types of cancer show a greater incidence among men than women, which may result from a different degree of exposure to environmental factors. The difference in the incidence rates increases with age, especially for respiratory cancer, leukemia, and cancer of the buccal cavity. This suggests a difference between men and women in terms of the intensity or amount of exposure to certain factors such as occupational hazards and social habits. Only cancer of the breast, reproductive organs, and certain endocrine glands was found to occur more frequently among women than men.

Commenting on the sex variation in cancer incidence, John R. Heller, director of the National Cancer Institute, observed that the risk of developing cancer is 60 percent greater for men than for women if genital and breast cancer are excluded. "This greater risk is related, in part, to the survey findings that cancer of the lung and bronchus occurs more than five times as frequently, and laryngeal cancer twelve times as frequently in men as in women."

The data further indicate that the death rate from cancer is now definitely higher for men than for women in the white population. This reversal of the relative standing of the sexes that had existed for whites until a few years ago is also expected to occur soon in the nonwhite population, in which the margin of female deaths over male is rapidly narrowing.

The report notes a positive correlation between cancer incidence and chronological age—the older the person the greater the likelihood of cancer. Half the people with diagnosed cancer, both men and women, were between 50 and 70 years of age. But great variations were found between men and women in the relative occurrence of cancer of different parts of the body and age at which the disease manifested itself. Men appear to be more susceptible to cancer than women in the first two and the last two or three decades of the usual lifetime, whereas women have a higher rate during the childbearing years. In fact, at about age 35, relatively twice as many women as men are found to have a malignant tumor. After the childbearing period, however, the male rate catches up with and exceeds the female rate.

In women, nearly half of all cancers originate in the reproductive organs and nearly one-fourth in the digestive system. Among men, the reproductive organs account for only one in eight cancers, while one-third originate in the digestive system.

The reported incidence of cancer in the nonwhite population is less than two-thirds of that for the white group, a difference due largely to the lower sus-

ceptibility of Negroes to skin cancer (which is one of the more common neoplasms among white persons). However, the age-adjusted mortality rates are almost identical for both races.

The data indicate that the incidence of cancer was about one-third greater for white persons living in the South and the West than for those living in the North, due in large measure to the higher incidence of skin cancer in these areas. Twenty-eight percent of newly diagnosed cases of cancer among white persons living in the South originate in the skin. Corresponding percentages for the West and North are 20 and 10, respectively.

■ Argonne National Laboratory has announced that temporary positions are again available for members of university and college faculties in the fields of biology, chemistry, engineering, medicine, metallurgy, and physics. Appointments will ordinarily be made in two categories: (i) for approximately 1 year, at the end of which the individual will return to his sponsoring institution; (ii) for the summer. Each candidate must be endorsed by his own academic institution. *Applications should be submitted by 15 Dec.* Further information may be obtained from the Associate Laboratory Director, Argonne National Laboratory, Box 299, Lemont, Ill.

■ At the 6th International Congress of Anatomy, held in Paris, 25-30 July, a revised draft of the nomenclature of human anatomy was presented by the International Committee on Anatomical Nomenclature set up by the Oxford Congress of 1950. This draft constitutes a moderate revision of the 60-year-old *Basel Nomenclature (BNA)*—incorporating, however, many improvements of the British and German revisions (BR and INA, 1933). It was accepted by an almost unanimous vote of the congress and was recommended to the constituent societies as the official terminology of human gross anatomy in Latin, to which the terminology of the respective vernacular languages should be made to conform as closely as possible.

A limited number of copies of the draft are available through Normand L. Hoerr, secretary of the American Association of Anatomists, Western Reserve University Medical School, Cleveland 6, Ohio. Formal publication of an edition for English-speaking countries is being arranged.

**Erratum:** In the issue of 2 September, page 421, the address of Hermann Druckrey, coauthor of the paper "Light-dependence of fluorescence of solutions of cigarette smoke," was incorrectly given as Sloan-Kettering Institute for Cancer Research, New York. Dr. Druckrey's address is Chirurgische Universitäts-Klinik, Hugstetterstrasse 53, Freiburg im Breisgau, Germany.

## Reports and Letters

### Alkaline Phosphatase in the Kidneys of Agglomerular Fish

Renal tubular alkaline glycerophosphatase has been demonstrated histochemically in most vertebrate species examined. Perhaps the only exceptions are those reported by Wilmer (1), who was unable to find the enzyme in the kidneys of the agglomerular toadfish, *Opsanus tau*, the spotted salamander, *Amblystoma maculatum*, and the snapping turtle, *Chelydra serpentina*. The widespread occurrence of this enzyme has justified the belief that it plays some fundamental role in kidney function (2). Because the agglomerular kidney does not have occasion for resorptive activity and is apparently incapable of excreting sugars (3), Wilmer provisionally interpreted the alleged absence of alkaline phosphatase in the tubule of the toadfish kidney as valid evidence of the relation of the tubular enzyme to glucose transport (1). His hypothesis has gained considerable acceptance (2, 4, 5).

Danielli has cast some doubt on the validity of this idea by incidental references to unpublished studies by Lorch and himself revealing the presence of tubular alkaline phosphatase "in a number of species of agglomerular fishes" (6, 7). The present communication calls attention to this finding and reports my own demonstration of tubular alkaline phosphatase in the three particular species reported negative by Wilmer.

Freshly caught specimens of *Opsanus tau*, *Amblystoma maculatum*, and *Chelydra serpentina* were obtained locally in season (8), and the kidneys were removed as soon as possible after capture. Fixation was carried out in 65-percent alcohol for 24 hours. After the specimens were imbedded and sectioned, alkaline phosphatase was demonstrated according to the method of Gomori.

Five specimens of *Opsanus tau* were examined. Although the kidneys were removed for fixation as soon as the fish was taken from the water, the results were distinctly variable, but strong local tubular activity was demonstrated in most tissue blocks (Fig. 1). Activity tended to be least at the centers of the blocks, suggesting a fixation artifact arising

from an unusual lability of the tubular alkaline phosphatase in this animal. No difficulty was encountered in demonstrating vigorous tubular activity in kidneys of two *A. maculatum* and one *C. serpentina*.

The evidence of enzyme lability noted in the toadfish seems to offer a reasonable explanation of Wilmer's negative findings. Although he does not state the source of the *A. maculatum* or *C. serpentina* examined by him, the *O. tau* had been for a long time in an aquarium. It is suggestive that Grafflin (9) has remarked on the lability of renal function in fishes in captivity. In addition to the experience related with toadfish, I have sometimes found it impossible to demonstrate alkaline phosphatase in the renal tubules of box turtles (*Terrapine carolina carolina*) that have been kept in the laboratory, although freshly caught specimens are well supplied with it. In any event, it is clear that acceptable evidence of the absence of this enzyme in any species can be based only on wide experience.

The general conclusions that arise from the distribution of tubular alkaline phosphatase among vertebrate species are altered by these findings and those cited by Danielli. Although the possibility cannot be excluded that this enzyme survives in agglomerular fishes as a vestigial characteristic inherited from

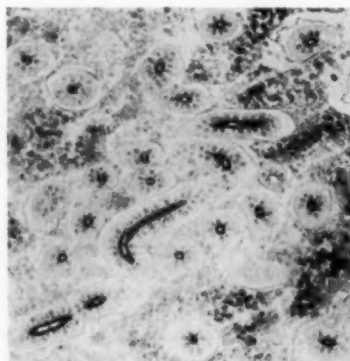


Fig. 1. Gomori alkaline phosphatase reaction in renal tubules of *Opsanus tau*. ( $\times 150$ )

their glomerular ancestors (10), its presence argues, barring this, against its involvement in glucose resorption. Conclusions with respect to the possible functional importance of tubular alkaline phosphatase based on its general distribution are reinforced by the reduction of the list of excepted species to none. The fact that individual animals under certain conditions can apparently exist without it does not necessarily contradict this estimate. Instead it may be that its function is of sufficiently general nature that alternative mechanisms exist which, in case of necessity, can accomplish a corresponding and vitally sufficient result.

J. B. LONGLEY

Laboratory of Pathology and  
Histochemistry, National Institute of  
Arthritis and Metabolic Diseases,  
Bethesda, Maryland

#### References and Notes

1. H. A. Wilmer, *Arch. Pathol.* 37, 227 (1944).
2. F. Moog, *Biol. Revs. Cambridge Phil. Soc.* 21, 41 (1946).
3. E. K. Marshall, Jr., *Physiol. Revs.* 14, 133 (1934).
4. J. Roche, in *The Enzymes*, Sumner and Myrback, Eds. (Academic, New York, 1950), vol. 1, p. 504.
5. H. W. Smith, *The Kidney* (Oxford Univ. Press, New York, 1951), p. 39.
6. J. F. Danielli, *Cytochemistry* (Wiley, New York, 1953), p. 71.
7. ———, *Proc. Roy. Soc. (London)* B142, 146 (1954).
8. I am indebted to the Chesapeake Biological Station, Solomons, Md., for assistance in obtaining the toadfish, and to Bill Witt for assistance in collecting the spotted salamanders.
9. A. L. Grafflin, *Am. J. Physiol.* 97, 602 (1931).
10. H. W. Smith, *Quart. Rev. Biol.* 7, 1 (1932).

31 May 1955

### Ultraviolet Irradiation of Pyrimidine Derivatives

The substances identified up to the present as products of the ultraviolet irradiation of pyrimidine compounds include ammonia, urea, oxamide, parabanic acid (1). These clearly arise by more or less extensive disruption of the pyrimidine ring. However, in 1949 Sinsheimer and Hastings (2) reported that uracil, uridine and also cytidylic acid, after brief irradiation with light of wavelength 254 m $\mu$  lost their characteristic ultraviolet absorption band and yielded a product that, on treatment with acid, spontaneously regenerated the original compound. More detailed information about this reaction has been reported recently by Sinsheimer (3). Since this reversible photoreaction may constitute an initial step in the more drastic photodecompositions it seemed to us important to know the structure of the "reversible" product.

A survey of variously substituted pyrimidine derivatives disclosed that 1,3-

dimethyl uracil (DMU) exhibited the same reversible type of photoreaction as uridylic acid, and its physical and chemical properties made it particularly suitable for the isolation of the product. We therefore irradiated 0.2M aqueous DMU with 254 mμ light (G.E. 15-w germicidal lamps), fractionated the product by partition between chloroform and water, and purified it by chromatography on alumina and by repeated recrystallization from mixtures of chloroform and *n*-hexane (4).

The isolated material is a white, crystalline solid, (mp 102°C) readily soluble in water and in ethanol, slightly soluble in chloroform and insoluble in *n*-hexane. Its aqueous solutions show only end-absorption in the ultraviolet (Fig. 1). On treatment either with acid (pH 1) or alkali (pH 10) it is rapidly and quantitatively reconverted to DMU, identifiable both by the detailed agreement of its ultraviolet absorption curve with that of known DMU (Fig. 1) and by its characteristic distribution coefficient of 3.47 between chloroform and water at 20°C.

Analysis of the isolated product of irradiation gave the results shown in Table 1. The mean value found for its molecular weight by the cryoscopic method was 158.3. This may be compared with an estimated equivalent weight of 157 with respect to reversion to DMU (mol. wt. 140).

The molecular weight, which differs by 18 from that of DMU, and the analytic data of Table 1 point to the conclusion that the product of irradiation arises by the addition of a molecule of water to DMU. The disappearance during irradiation of DMU of the characteristic reaction with bromine water (5), which is known to involve addition at the 5:6 double bond, together with the loss of the absorption band at 265 mμ, which

Table 1. Analysis of the product of irradiation of DMU.

	Calculated for DMU $C_8H_8O_2N_2$ (%)	Calculated for $C_8H_{10}O_3N_2$ * (%)	Observed (mean values)
Carbon	51.4	45.58	45.55
Hydrogen	5.71	6.33	6.38
Nitrogen	20.00	17.72	17.69

\* That is, DMU plus a molecule of water.

also involves this double bond as part of the chromophore (6), suggests that the product is either the 6- or 5-hydroxy-1,3-dimethyl hydrouracil. The presence of an —OH group is further indicated by the observation of a strong band at 2.98 μ in the infrared absorption spectrum of the isolated product in alcohol-free chloroform, a band that is absent from similar solutions of DMU. This is also in keeping with the increased polarity of the product over DMU, as is evidenced by its much lower distribution coefficient (0.03) in a chloroform-water system.

Attempts to synthesize 6-hydroxy-1,3-dimethyl hydrouracil have so far been unsuccessful. Reduction of 6-hydroxy-5,5-dibromo-1,3-dimethyl hydrouracil catalytically with platinum and hydrogen, with continuous neutralization of the hydrobromic acid liberated, has yielded mainly DMU. However, it was found that the platinum catalyst itself also catalyzed the recovery of the isolated irradiation product to DMU, even in neutral solution, so that this result is in keeping with the postulated structure, although it does not prove it. Reduction methods involving the use of strong acid or alkali are ruled out because of the lability of the desired compound at extremes of pH.

That uracil and uridylic acid react similarly to DMU on irradiation is indicated by a number of parallels in their behavior. (i) The product of irradiation in each case can regenerate the original compound on treatment with either acid or alkali. [It should be noted that with respect to the alkaline conditions our finding differs from that of Sinsheimer (3).] (ii) Simultaneously with the loss in ultraviolet absorption during irradiation, all these compounds lose their ability to react rapidly with bromine water, indicating loss of the 5:6 double bond. (iii) The product of irradiation of uracil is more polar than uracil itself, as is indicated by its lower  $R_f$  on a paper chromatogram employing *n*-butanol saturated with water as mobile phase. The product in this case is easily located by the ultraviolet photographic method of Markham

and Smith (7) after the developed chromatogram has been exposed to HCl vapor to regenerate the uracil.

If our conclusion regarding DMU is correct, the analogous product for uracil should be either 6- or 5-hydroxy hydrouracil. The 5-hydroxy compound is known (8) and does not have the required properties. The 6-hydroxy compound, on the other hand, does not appear to have been described. We believe that this omission is a result of the extreme facility with which it loses water to form uracil.

A. M. MOORE

C. H. THOMSON

Biology Division, Atomic Energy of Canada, Ltd., Chalk River, Ontario

#### References and Notes

1. A. Canzanelli, R. Guild, D. Rapport, *Am. J. Physiol.* 167, 364 (1951); W. E. Conrad, *Radiation Research* 1, 523 (1954).
2. R. L. Sinsheimer and R. Hastings, *Science* 110, 525 (1949).
3. R. L. Sinsheimer, *Radiation Research* 1, 505 (1954).
4. A detailed report of the isolation procedure and the kinetics of the photodecomposition and regeneration is in preparation. We are indebted to Leo Marion, National Research Council, Ottawa, for the carbon and hydrogen analyses, and to W. M. Thurston of the Chemistry Branch, Atomic Energy of Canada, Ltd., Chalk River, for the infrared spectra.
5. T. B. Johnson and S. H. Clapp, *J. Biol. Chem.* 5, 49 (1908).
6. L. F. Cavalieri *et al.*, *J. Am. Chem. Soc.* 70, 3875 (1948).
7. R. Markham and J. D. Smith, *Biochem. J.* 45, 294 (1949).
8. E. Fischer and G. Roeder, *Ber. deut. chem. Ges.* 34, 3751 (1901).

25 April 1955

#### Tartronate as a Possible Coenzyme of Oxalosuccinic Carboxylase

Oxalosuccinic carboxylase catalyzes the oxalosuccinate → α-ketoglutarate decarboxylation in the citric acid cycle and is known to be activated by  $Mn^{++}$  in acid solution (1). In the work reported here, tartronate (hydroxymalonate) was found to act as coenzyme of oxalosuccinic carboxylase at physiological pH. This was indicated by two methods: (i) titration of the carbonate formed by the decarboxylation and (ii) measurement of the optical activity of the reaction mixture.

**Method A, titration of the carbonate.** Veal heart was ground, extracted with acetone, and dried in a vacuum (1). Water (2 ml) added to the sample (0.5 g) was hard-frozen and melted; the sample was pressed and washed (4 × 1 ml water) with a 10-minute interval between washings. This extract was dialyzed 18 hours against cold water as a thin (2- to 3-mm) layer in a closed cellulose sack from which most of the air was expelled before it was tied off, and which was clamped between two sheets of 10-mesh,

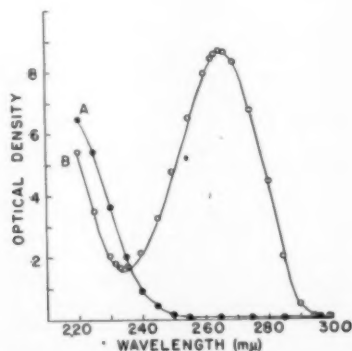


Fig. 1. Absorption curves. A, product of irradiation,  $10^{-4}M$  in water. Points on B, product of irradiation,  $10^{-4}M$ , after heating at 100°C for 5 min at pH 1.0. Solid curve B,  $10^{-4}M$  DMU in water.

silver-plated copper gauze. The volume of liquid in the sack remained quite constant. The volume was made 5 ml, the pH was made 7.2, and the CO<sub>2</sub> was expelled by applying low pressure (Hyvac, 16- by 150-mm Pyrex test tube) a number of times (the tube was vented as the foam rose). After each cycle, the pH was readjusted to 7.2, and low pressure was again applied, until a constant pH of 7.2 was obtained. The volume was maintained constant by the addition of water.

The substrate was prepared by shaking oxalosuccinic triethyl ester (2) (0.8 g) with HCl (2 ml, 37 percent) for 1 hour, after which it was allowed to stand at room temperature overnight. A portion of this solution (0.2 ml, 60 mg oxalosuccinic acid) was neutralized (ice bath) with 3N NaOH, tartronic acid (3) (1 or 5 mg, 1 ml, pH 7.2) or water (1 ml) was added, and the CO<sub>2</sub> was expelled. Extract (1 ml, equivalent to 0.1 g of the acetone-dried tissue) and, finally, Mn<sup>++</sup> (1 drop, 0.20 mg MnCl<sub>2</sub> · 4 H<sub>2</sub>O, 0.06 mg Mn<sup>++</sup>) were added (total volume, 3 ml), and the time was noted. The CO<sub>2</sub> from

the decarboxylation was expelled at frequent intervals for 15 minutes. The standardized HCl (a convenient concentration is 1.85 ml concentrated HCl in 100 ml) required during this interval measured the NaHCO<sub>3</sub> formed by the decarboxylation (Table 1). This titration method was tested, using the same procedure on a solution similarly prepared, except that concentrated HCl (0.2 ml) was substituted for the oxalosuccinic-HCl; NaHCO<sub>3</sub> (5 mg) was added to the solution that had been stabilized at pH 7.2, and the CO<sub>2</sub> was expelled as described in the preceding paragraph: found, 4.7 mg NaHCO<sub>3</sub>.

*Method B, measurement of optical activity.* The rotation appearing in the reaction mixture because of the enzymatic decarboxylation of a portion of one optically active enantiomorph of oxalosuccinic acid to the inactive α-ketoglutaric acid was measured to compare the relative activity of the carboxylase with and without the additives. The moistened (with 4 ml water) acetone-extracted tissue (1 g) was hard-frozen,

Table 3. Relative concentration of the components used in methods A and B

Component	Method A	Method B
Extract	33%	60%
Oxalosuccinic acid	2	3.5
Tartronic acid	0.033 or 0.165	0.03 or 0.3
Mn <sup>++</sup>	0.002	0.0035

washed (4 × 2 ml), and dialyzed as it was for method A. The substrate was prepared by cooling (ice-salt) the oxalosuccinic-HCl solution (2 ml, 0.6 g substrate) in a 15-ml centrifuge tube, adding NaOH (0.7 g in 1 ml water) with stirring, centrifuging, and then pouring off the supernatant from the precipitated NaCl for further neutralization with 3N NaOH. Tartronic acid (5 or 50 mg) was added in small portions, with stirring, to the neutralized substrate, and the pH of the solution was kept at 8.0 to 8.5 to avoid a temporary drop to below 7.0. The total dialyzed extract was added, the pH was adjusted to 7.2, and finally Mn<sup>++</sup> (10 drops, 0.6 mg Mn<sup>++</sup>) was added. The reaction mixture was maintained at pH 7.2 to 7.3 without removal of the CO<sub>2</sub>, and, at the end of 15 minutes at 25°C, powdered NaCl (2 g) and 3N NaOH (1 ml, producing a pH of 10.8) were added to slow further decarboxylation. The rotation was measured after centrifuging and filtering through asbestos (two Gooch crucibles for greater speed). The measurements (Table 2) were made with a Landolt precision polarimeter, an Osram lamp, and a 200-mm tube (capacity, 17 ml).

The desirability of increasing the angle of rotation required an increase in the concentration of the components in method B from that in method A (Table 3). This necessitated a partial removal of the NaCl, which is enzyme-inhibitory in too great concentration, since the limited volume of the polarimeter tube did not allow dilution, as was done in method A. In method A a similar increase was not advisable, because the time required for the removal of the CO<sub>2</sub> would have been unnecessarily prolonged.

Thus, although the results obtained by methods A and B do not entirely agree concerning the relative rates of decarboxylation, it may be seen that in both methods a marked increase was produced by tartronate at physiological pH when tartronate was used in conjunction with the activator Mn<sup>++</sup>.

The amount of tartronic acid dialyzed in 18 hours from acetone-extracted veal heart was about 10 mg/g (#). Apparently, the tartronate is present in combined, acetone-insoluble form in the ace-

Table 1. Relative activity, as indicated by method A, of oxalosuccinic carboxylase, with and without tartronate and Mn<sup>++</sup>, at a temperature of about 25°C and pH 7.2 to 7.3

Expt.	Extract added to oxalosuccinic acid (60 mg)	NaHCO <sub>3</sub>	Percentage of theoretical
1	Boiled, dialyzed extract, 5 mg tartronic acid, 0.06 mg Mn <sup>++</sup>	0.80 mg	
2	Undialyzed extract	2.06*	17
3	Dialyzed extract	0.05*	0.4
4	Dialyzed extract, 5 mg tartronic acid	0.48*	4
5	Dialyzed extract, 0.06 mg Mn <sup>++</sup>	0.96*	8
6	Dialyzed extract, 1 mg tartronic acid, 0.06 mg Mn <sup>++</sup>	1.60*	13
7	Dialyzed extract, 5 mg tartronic acid, 0.06 mg Mn <sup>++</sup>	2.72*	22
8	Same as for No. 7, but without oxalosuccinic acid	0	
9	Theoretical value for complete reaction†	12.46*	

\* Corrected for spontaneous decarboxylation, and so forth, as represented by the value of No. 1.

† Assuming the formation of 1 molecule of NaHCO<sub>3</sub> per molecule of one enantiomorph.

Table 2. Relative activity, as indicated by method B, of oxalosuccinic carboxylase, with and without tartronate and Mn<sup>++</sup>, at 25°C and pH 7.2 to 7.3

Expt.	Extract	Rotation*
1	Undialyzed extract without oxalosuccinic acid†	-0.10 ± 0.02°
2	Dialyzed extract without oxalosuccinic acid†	-0.06 ± 0.02°
3	Undialyzed extract with 0.60 g oxalosuccinic acid	-0.19 ± 0.02°‡
4	Dialyzed extract with 0.60 g oxalosuccinic acid	-0.07 ± 0.01°‡
5	No. 4 with 50 mg tartronic acid	-0.05 ± 0.02°‡
6	No. 4 with 0.6 mg Mn <sup>++</sup>	-0.06 ± 0.02°‡
7	No. 4 with 5 mg tartronic acid and 0.6 mg Mn <sup>++</sup>	-0.14 ± 0.02°‡
8	No. 4 with 50 mg tartronic acid and 0.6 mg Mn <sup>++</sup>	-0.17 ± 0.03°‡
9	No. 7 with 200 mg K <sub>2</sub> HPO <sub>4</sub>	-0.18 ± 0.03°‡
10	No. 8, except that the dialyzed extract was boiled	0 ± 0.01°‡

\* The rotation corresponding to a known amount of one enantiomorph of this extremely unstable acid is not known, and hence percentage values cannot be given. For comparison: the rotation given by 0.21 g L-malic acid, equimolar with one enantiomorph of the oxalosuccinic acid used, alkalinized by NaOH to pH 10.8, was measured and found to be -0.32°.

† HCl (2 ml, 37 percent) was substituted for the oxalosuccinic-HCl solution (2 ml); otherwise the procedure was the same as for No. 8. This rotation did not diminish with time, as did that produced by enzymatic decarboxylation (for example, a No. 3 sample lost 0.06° in 3 hours at 25°C). Approximately ½ hour was required for filtration and measurement.

‡ Corrected for No. 1 or 2, respectively.



tone-dried tissue and becomes dialyzable only after hydrolysis.

Since tartronate facilitates oxalosuccinic decarboxylation, and since it is a constituent of animal tissues, it may reasonably be considered a significant factor in the citric acid cycle. A tissue deficiency of tartronate (a plant, but not an animal product, 5), which might be caused by an insufficient intake because of dietary habits, loss in the preparation of food (volatility with steam, 6, and also 7, discarding of water extracts), faulty assimilation or retention, and so forth, could bring about a disturbance of the cycle. The resultant accumulation of pyruvate and acetate would lead to an abnormal amount of fat formation (6) and thus an excessive requirement for insulin (8). If this state were sufficiently prolonged, disorders of the endocrine control of carbohydrate metabolism might be induced. Hindrance in the formation of succinyl coenzyme-A, which makes possible the degradation of the fatty acids (9) and entrance into the cycle of acetoacetyl coenzyme-A (10) from both fatty acid and carbohydrate catabolism might also be caused by tartronate deficiency.

LAURENCE G. WESSON\*

Research Department, Forsyth Dental  
Infirmary for Children,  
Boston, Massachusetts

#### References and Notes

1. S. Ochoa and E. Weiss-Tabori, *J. Biol. Chem.* 159, 245 (1945).
2. W. Wislicenus and M. Waldmüller, *Ber. deut. chem. Ges.* 44, 1564 (1911).
3. B. Bak, *Ann. Chem. Justus Liebig* 537, 286 (1939); manufactured by Aldrich Chemical Co., Milwaukee, Wis.
4. L. G. Wesson, a description of a method for the estimation of tartronate in tissues is in preparation.
5. W. K. Rieben and A. B. Hastings, *Helv. Physiol. et Pharmacol. Acta* 4, C52 (1946).
6. L. G. Wesson, *Endocrinology* 47, 302 (1950).
7. ———, *Proc. Soc. Exptl. Biol. Med.* 44, 208 (1940).
8. D. R. Drury, *Am. J. Physiol.* 131, 536 (1940-41); L. Rice and E. A. Evans, Jr., *Science* 97, 470 (1943); D. Stetten, Jr. and B. V. Klein, *J. Biol. Chem.* 159, 593 (1945); K. Bloch and W. Kramer, *ibid.* 173, 811 (1948).
9. F. Lynen, *Federation Proc.* 12, 683 (1953); F. Lynen and S. Ochoa, *Biochem. et Biophys. Acta* 12, 299 (1953).
10. D. E. Green, *Science* 115, 661 (1952); J. R. Stern, M. J. Coon, A. Del Campo, *Nature* 171, 28 (1953); *J. Am. Chem. Soc.* 75, 1517 (1953).

\* Present address: Massachusetts Institute of Technology, Cambridge, Mass.

25 May 1955

## Occurrence of Diffusible

### Auxin in *Psilotum*

Auxin first became known as a growth hormone of flowering plants, of the oat coleoptile in particular (1). Since its discovery in the Pteropsida, Seidl (2) has reported auxin from the Lycopsida, Wetmore and Morel (3) from the Sphenopsida, von Witsch (4) from Bryophyta,

Nielsen (5) from Fungi, and van der Weij (6) from Algae. Thus auxin has been reported to occur in at least some member of every major group of plants, with the sole exception of Psilopsida. From the standpoint of comparative biochemistry and because the Psilopsida is an extremely primitive, rootless, leafless, and mostly extinct group of vascular plants, it is of interest to see whether living members of this group also produce auxin.

Stem tips 5 millimeters long were cut from aerial stems of *Psilotum nudum*, placed basal cut surface down on 1.5-percent agar blocks, and allowed to stand for 3 hours in normal diffuse room light. During the diffusion the agar blocks were placed on glass slides in a petri dish containing wet filter paper, to prevent desiccation of the agar. The standard *Avena* bioassay for auxin was used (7).

When thick, fast-growing stems were used for diffusion tests, substantial curvatures were obtained in the *Avena* bioassay—for example, two thick tips diffused onto 12 blocklets gave mean curvature per blocklet of 12.5°. When slower-growing stem tips were tested, no detectable auxin was found.

The absence of roots in Psilopsida is of particular interest to a student of auxin physiology, because a stimulating effect of added auxin on the number of roots or rhizoids developed has been observed in many plant groups, particularly in the Angiospermae. Although this rhizogenic activity has not been confirmed from as many major plant groups as has the occurrence of auxin, yet pure auxin has been shown to have a rhizogenic stimulation per se in Pteropsida by Thimann and Koepfli (8), in Lycopsida by Williams (9), in Bryophyta by Fitting (10), and in Algae by Jacobs (11). Accordingly, cuttings from both aerial and underground stems were treated with various concentrations of synthetic auxins (indole-acetic acid, naphthalene acetic acid, indole butyric acid), alone and in combination, with a medium containing substances known to limit the growth of excised angiospermous roots—that is, thiamine, nicotinic acid, sucrose, and mineral salts. Cuttings were checked macroscopically, under a binocular dissecting microscope, and finally under a compound microscope, after they had been paraffin imbedded, serially sectioned, and double stained. In no case were roots or root primordia detected.

Both the normal presence of auxin in *Psilotum* stems and the absence of root initiation in the auxin-treated cuttings support the interpretation that auxin is not the limiting factor for root initiation in *Psilotum*. However, since the reports for other plant groups show that auxin stimulates root formation only in groups where roots are normally formed, while it

stimulates rhizoids in the groups which normally form rhizoids, it may well be that auxin does have a rhizogenic effect in *Psilotum*, but acts on the initiation of rhizoids rather than on the initiation of roots.

Attempts to induce rooting in *Psilotum* are continuing.

WM. P. JACOBÉ

Biology Department, Princeton  
University, Princeton, New Jersey

#### References

1. F. W. Went, *Rec. trav. botan. néerl.* 25, 1 (1928).
2. W. Seidl, *Jahrb. wiss. Botan.* 89, 632 (1941).
3. R. H. Wetmore and G. Morel, *Am. J. Bot.* 36, 830 (1949).
4. H. von Witsch, *Planta* 39, 664 (1940).
5. N. Nielsen, *Jahrb. wiss. Botan.* 73, 125 (1930).
6. H. G. van der Weij, *Proc. Koninkl. Akad. Wetenschap. Amsterdam* 36, 759 (1933).
7. F. W. Went and K. V. Thimann, *Phytohormones* (Macmillan, New York, 1937), p. 21.
8. K. V. Thimann and J. B. Koepfli, *Natura* 135, 101 (1935).
9. S. Williams, *ibid.* 139, 966 (1937).
10. H. Fitting, *Jahrb. wiss. Botan.* 88, 633 (1939).
11. W. P. Jacobs, *Biol. Bull.* 101, 300 (1951).

18 May 1955

## Isomeric Substituted-Vinyl Phosphates as Systemic Insecticides

Substituted-vinyl phosphates have been frequently noted for their high insecticidal activity (1, 2). Their pharmacological action on mammals has also been investigated (3). One of these materials, designated as compound 2046 or 0,0-dimethyl 2-carbomethoxy-1-methylvinyl phosphate, is a very efficient short-residual systemic insecticide (4). This carbomethoxy material was studied along with its carbethoxy analog, 0,0-diethyl 2-carbomethoxy-1-methylvinyl phosphate and its chloro analog, 0,0-diethyl 2-chlorovinyl phosphate (3).

Different preparations of the carbethoxy analog were found to vary greatly in systemic insecticidal activity, even though all were colorless liquids with identical sharp boiling points. Fractionation of several samples of the three analogs by partition chromatography on silica gel columns yielded two fractions from the carbomethoxy and carbethoxy materials and three components from the chlorovinyl phosphate. The first material eluted with organic solvents ( $\alpha$ ) was 5 to 100 times more toxic to insects than the more water-soluble fractions next eluted ( $\beta$  and  $\gamma$ ).

Two geometric isomerides are possible with substituted-vinyl phosphates. *Trans* isomers are known to be generally more stable than *cis* isomers, because of the greater strain at the double bond in the *cis* materials. With the carbomethoxy, carbethoxy, and chlorovinyl phosphates, the  $\alpha$  fractions were always the most active antiesterases, the least stable to

oxidative attack and hydrolysis of the phosphoric anhydride bonds, and the least water-soluble materials. An infrared absorption peak appeared between 11.00 and 11.10  $\mu$  with the  $\alpha$  fractions but not with the  $\beta$  and  $\gamma$  fractions. Starting with either the  $\alpha$  or  $\beta$  fraction from the carbethoxy analog, irradiation with ultraviolet light yielded a mixture of approximately 30-percent  $\alpha$  and 70-percent  $\beta$  material as shown by infrared analysis. If the  $\alpha$  and  $\beta$  fractions are isomeric, treatment of either isomer with ultraviolet light should produce a mixture of isomers with the more stable *trans* configuration predominating. All the experimental evidence is consistent with the hypothesis that the active  $\alpha$  fraction is the *cis* isomer for each of the substituted-vinyl phosphates.

The properties of the *cis* and *trans* carbethoxy analog are shown in Table 1. Comparison of the vinyl phosphates as anticholinesterase agents showed that the isomeric dimethyl phosphates were combining in a different manner with the enzyme than the diethyl phosphates (the comparison was based on the slopes of the inhibition curves). The difference in anticholinesterase activity of the isomers increased as the size of the group hindered in rotation by the rigidity of the double bond increased. A consideration of isomeric yields from different synthesis methods explained the difference in bio-

logical activity of various preparations.

The biological distribution and fate of the *cis* isomer of compound 2046 was studied by means of radiotagged material ( $P^{32}$ ). It was found that in contrast to other systemic insecticides currently available (5), compound 2046 does not require a preliminary "metabolic activation" within the plant (this finding is based on parallel radioactivity, bioassay, and anticholinesterase analyses) or within the insect or mammal (these findings are based on activation experiments with rat liver slices and cockroach intestines, 6) to produce the effective toxicant. Accordingly, the anticholinesterase method was standardized to give a residue analysis procedure sensitive to 0.05 ppm. Field residual studies on a technical sample of compound 2046 (67 percent *cis*, 33 percent *trans*, Shell Development Co.) on 13 vegetable crops showed less than 0.1 ppm of residue 4 days after treatment of the soil or foliage with  $\frac{1}{4}$  lb per acre of the insecticide. The substituted-vinyl phosphates had the shortest residual period of 20 organophosphates studied on carrots, potatoes, and cabbage. Immediately following treatment, the major loss of compound 2046 from plants was the result of volatilization, but about 12 hours later the decomposition within the plant became the significant factor. This enzymatic detoxification occurred throughout the plant and yielded a half-

life in young greenhouse pea plants of about 20 hours for *cis* 2046 and about 48 hours for the *trans* isomer.

The distribution, detoxification, and esterase specificity of *cis* 2046 was investigated for the white rat and American cockroach. Detoxification appeared to take place in the plasma of the rat and in the gastric caeca and nerve cord of the roach. Compound 2046 did not appear to be selectively localized in the rat but accumulated in the mid- and hindgut of the roach. Esterase specificity tests *in vivo* and *in vitro* showed this *cis* carbomethoxy phosphate to be one of the most selective inhibitors of acetylcholinesterase that we have found in our studies to date.

Biological specificity of geometric isomerides has been frequently observed. To my knowledge, this is the first demonstration of *cis-trans* specificity with organophosphate antiesterases. A description of the experimental details of this study on vinyl-substituted phosphates is in preparation.

JOHN E. CASIDA

Department of Entomology,  
University of Wisconsin, Madison

#### References and Notes

- G. Schrader, *Angew. Chem. Monogr. No. 62* (1952).
- R. A. Corey et al., *J. Econ. Entomol.* 46, 386 (1953) and *Science* 118, 28 (1953); E. E. Ivy, *Agr. Chemicals* 8, 47 (1953); A. M. Mattson, J. T. Spillane, G. W. Pearce, *J. Agr. and Food Chem.* 3, 319 (1955).
- J. K. Kodama, M. S. Morse, C. H. Hine, *Federation Proc.* 12, 337 (1953); M. S. Morse, J. K. Kodama, C. H. Hine, *Proc. Soc. Exptl. Biol. Med.* 83, 765 (1953).
- Approved for publication by the director of the Wisconsin Agricultural Experiment Station. This investigation was supported in part by a research grant from the Shell Development Co., Denver, Colo. Compound 2046 is a systemic insecticide developed by the Shell Development Co.
- J. E. Casida and M. A. Stahmann, *J. Agr. and Food Chem.* 1, 883 (1953); R. L. Metcalf et al., *J. Econ. Entomol.* 47, 1045 (1954).
- J. E. Casida, T. C. Allen, M. A. Stahmann, *Nature* 172, 243 (1953); R. L. Metcalf and R. B. March, *Ann. Entomol. Soc. Amer.* 46, 63 (1953).
- A. R. Stiles, U.S. Patent No. 2,685,552, 3 Aug. 1954.

5 May 1955

#### Atomic Charges in Monosubstituted Benzenes

Newly available information on charge distribution in molecules (1, 2), even though it is somewhat speculative, should certainly be of interest in the field of aromatic substitution where no completely satisfactory interpretive theory has yet been developed (3). This paper presents such data for a number of monosubstituted benzenes.

Table 1 lists the substituents in order of decreasing electron release to, or increasing withdrawal from, the ring. The partial charge on the atom of the substituent group that is directly attached to

Table 1. Properties of *cis* and *trans* 0,0-diethyl 2-carbethoxy-1-methylvinyl phosphate

Item	<i>cis</i>	<i>trans</i>	Biological activity ratio <i>cis/trans</i> *
<b>Partition coefficients†</b>			
CCl <sub>4</sub> /H <sub>2</sub> O	58	14	
n-Hexane/H <sub>2</sub> O	5.5	1.1	
<b>Chemical reactivity</b>			
Hydrolytic half-life ( $-\text{P}=\text{O}-\text{C}=\text{C}$ ) (hr)‡	3.4	9.0	
Oxidative half-life ( $\text{MnO}_4^-$ ) (min)§	8.9	15.4	
<b>Biological activity</b>			
Blood cholinesterase, <i>in vitro</i> $\text{pI}_{50}$	7.75	5.93	66
Rat LD <sub>50</sub> , intraperitoneal (mg/kg)¶	0.35	35	100
Fly LD <sub>50</sub> , topical (mg/kg)**	2.0	59	30
Aphid LD <sub>50</sub> , systemic (ppm)††	10.5	770	73
<b>Method of synthesis</b>			
Schrader (1) (% yield)	5-9	91-95	
Stiles (7) (% yield)	67	33	

\* A ratio of the reciprocal of the amount of the *cis* isomer divided by the reciprocal of the amount of the *trans* isomer required to produce the same end-point.

† 2.0 mg organophosphate partitioned between 2.0 ml organic solvent and 2.0 ml distilled water at 28°C.

‡ Half-life in hours of vinyl phosphate bond at 28°C and pH 11.6 (0.1M Na<sub>2</sub>CO<sub>3</sub>) based on loss of partitioning properties into chloroform as diethyl phosphoric acid is formed on hydrolysis.

§ Half-life in minutes of 0.0004M KMnO<sub>4</sub> in acetone solution in the presence of 0.015M vinyl phosphate at 28°C, determined colorimetrically at 530 mμ.

|| Negative logarithm of molar concentration effecting 50-percent inhibition of esterase activity of whole human blood on acetylcholine with 1-hour preincubation of phosphate and enzyme prior to addition of substrate.

¶ Based on mortality of 250-g white rats 24 hours after intraperitoneal injection of organophosphate in isotonic saline.

\*\* Based on mortality 24 hours after application of organophosphate in 1.3 μlit of acetone to the pronotum of 3-day-old adult male houseflies.

†† Insecticide needed for 50-percent mortality of pea aphids after 8 hours of feeding on pea plants pre-treated for 24 hours by immersing the roots in the indicated insecticide solution.



Table 1. Effect of substituents in benzene ring

Substituent	Charge* withdrawal (+) from ring	Charge* on atom next to ring	$\delta C^*$	$\delta H^*$	Conju- gation with ring	Orien- tation effect
O <sup>-</sup>	-0.627	-0.373	-0.084	-0.025	None	o,p
Si(CH <sub>3</sub> ) <sub>3</sub>	-0.241	0.289	-0.049	0.011	None	o,p(weak)
C(CH <sub>3</sub> ) <sub>3</sub>	-0.085	-0.035	-0.035	0.025	None	o,p
CH <sub>3</sub>	-0.052	-0.032	-0.032	0.028	None	o,p
H	-0.030	0.030	-0.030	0.030	None	
C <sub>6</sub> H <sub>5</sub>	0	-0.027	-0.027	0.033	Possible	o,p
NH <sub>2</sub>	0.092	-0.176	-0.019	0.042	None	o,p
CH <sub>2</sub> Cl	0.171	-0.012	-0.012	0.049	None	o,p
OCH <sub>3</sub>	0.174	-0.309	-0.012	0.049	None	o,p
CN	0.180	-0.011	-0.011	0.050	Possible	m
COCH <sub>3</sub>	0.181	-0.011	-0.011	0.050	Possible	m
OH	0.247	-0.303	-0.005	0.056	None	o,p
Cl	0.251	-0.251	-0.005	0.056	None	o,p
CHO	0.252	-0.005	-0.005	0.056	Possible	m
CHCl <sub>2</sub>	0.400	0.008	0.008	0.070	None	o,p
N(CH <sub>3</sub> ) <sub>3</sub> <sup>+</sup>	0.446	-0.148	0.012	0.074	None	m
COOH	0.480	0.015	0.015	0.077	Possible	m
CCl <sub>3</sub>	0.634	0.029	0.029	0.091	None	m
NO <sub>2</sub>	0.671	-0.129	0.033	0.095	Possible	m
SO <sub>3</sub> H	0.736	-0.039	0.038	0.101	Possible	m
NH <sub>4</sub> <sup>+</sup>	0.805	-0.120	0.043	0.105	None	m
CF <sub>3</sub>	0.975	0.060	0.060	0.123	None	m

\* All charge values were calculated by the methods described in references 1 and 2.

the ring, as well as the partial charges on carbon and hydrogen atoms, is given. Also indicated are the possibility of substituent conjugation with the ring and the usual orientation effect. It is extremely important in studying the charge data to keep in mind that they represent solely the partial charges that would be expected from bond polarities resulting from initial electronegativity differences. The mobility of certain electrons in these multiple-bonded systems also has an important influence on the over-all charge distribution in the molecule, but the quantitative effect of this influence cannot easily be reckoned.

If the general reactivity of a benzene ring may be taken as a reflection of the availability of pi electrons, the data of Table 1 are of especial interest. Electron availability will be determined chiefly by two factors: the charge on the carbon atom, and the capacity of the rest of the molecule to supply electrons without the result of excessive positive charge on any one atom. The first factor is evaluated in Table 1; the lower the positive charge or the higher the negative charge on carbon, the greater the electron availability. The second factor depends essentially on the number and kinds of atoms of the substituent group: if the electron release to the ring is equal for two different substituents, the substituent that is the better electron reservoir will contribute more to the availability of pi electrons.

The problem of orientation effects of substituents on the benzene ring seems

too complex to be susceptible to complete solution by any one simple rule or formula. In part, the complexity may arise from differences in polarizing effects exerted by attacking molecules. These differences require a different interpretation of each substitution. The following observations from Table 1 are of interest, however. Groups that are predominantly meta directors are generally either highly electronegative groups with strong electron-withdrawing power and with a positively charged atom attached directly to ring carbon, or groups of lesser withdrawing power that have a multiple bond capable of conjugation with the ring. Groups that are predominantly ortho, para directors are usually either electron-releasing groups, or electron-withdrawing groups in which the atom attached directly to ring carbon has an appreciable negative charge. The latter type may be regarded as an example of the electrostatic influence on pi electrons that is exerted by high charge on the substituent atom directly attached to ring carbon (4). This charge, if it is negative, may tend to compensate for the electron withdrawal by the group by repulsion of the pi electrons. Similarly, the weakness of the ortho, para directing powers of the (CH<sub>3</sub>)<sub>3</sub>Si-group (5), despite the group's strong electron-releasing action, may be associated with the electrostatic attraction of the positively charged silicon for the pi electrons.

R. T. SANDERSON

Department of Chemistry,  
State University of Iowa, Iowa City

## References and Notes

1. R. T. Sanderson, *J. Chem. Educ.* 31, 2, 238 (1954); 32, 140 (1955).
2. —, *Science* 121, 207 (1955).
3. See, for example, L. B. Ferguson, *Electronic Structures of Organic Molecules* (Prentice-Hall, New York, 1952); A. E. Remick, *Electronic Interpretations of Organic Chemistry* (Wiley, New York, ed. 2, 1949); and similar works.
4. A similar effect, in the addition to olefinic double bonds, has been noted elsewhere: R. T. Sanderson, *Science* 122, 244 (1955).
5. J. L. Speier, *J. Am. Chem. Soc.* 75, 2930 (1953).

16 May 1955

## Polygonization of a Plastically Bent Sapphire Crystal

If one thinks of edge-type dislocations as arising formally from the insertion of an extra partial plane of atoms, then a plastically bent crystal must have more of these wedges going in from the convex surface than from the concave one (1). From the extensive work on polygonization of plastically bent metal crystals it has been shown that thermal activation can induce these excess dislocations of like sign to segregate and form plane walls perpendicular to the slip planes (2). In fact, these walls are simply small-angle grain boundaries, which then separate blocks or polygons of unbent structure. Each recovered block thus differs slightly in orientation from its neighbors.

In recent years it has been demonstrated that many ionic crystals that are hard and brittle at room temperature can be deformed plastically at elevated temperatures (3). Of particular interest, from the point of polygonization, is the case of plane bending of crystals that deform on only one slip system. Figure 1 illustrates the geometry of a bent sapphire (Al<sub>2</sub>O<sub>3</sub>) (4). It shows in particular that the slip planes curve into in-

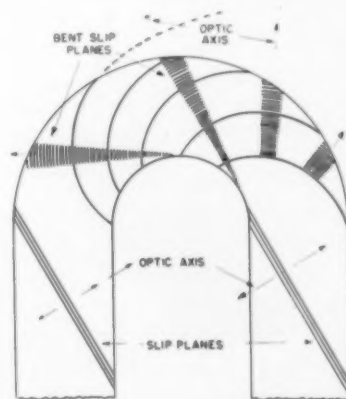


Fig. 1 Plane bending by slip on a single set of planes. The bent slip planes have the shape of an involute of a cylinder. Normals to the curved planes define the positions of the optic axis.

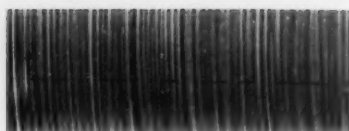


Fig. 2. Slip lines on the convex surface of a plane bent sapphire crystal. ( $\times 125$ )

volutes, yet the normals to these planes are preserved as straight lines. Accordingly, if polygonization can be induced in such a sample, then the positions of the dislocation walls should be defined by planes normal to the plane of the figure and parallel to the optic axis.

It is pertinent to realize a significant difference between the structures of an edge-type dislocation in a simple metal such as zinc and a structurally similar crystal such as sapphire. In the former, a single extra partial plane is required as an insert, whereas for the latter a double one is needed. Thus, for sapphire, it will be composed of contiguous planes of oxygen ions and aluminum ions, respectively. Since polygonization requires both glide and climb of dislocations, it is therefore implicit that the process necessitates self-diffusion of both types of ions.

In order to evaluate these various simple concepts, the following experiment was performed. A long, single crystal rod of Linde synthetic sapphire was plane bent in an oxygen-gas flame at a temperature of the order of  $1800^{\circ}\text{C}$ . Microscopic examination of the deformed sample showed well-developed slip lines (Fig. 2) when viewed normal to the axis of bending but none could be detected when viewed parallel to the axis, in accordance with the requirements for plane bending. Significantly, no evidence was obtained for polygonization at this stage.

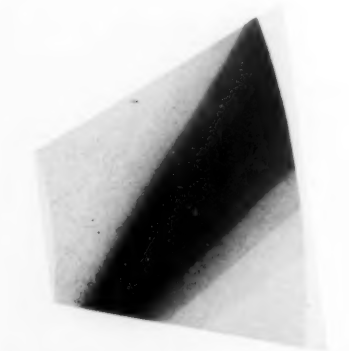


Fig. 3. Portion of a plane bent and polygonized sapphire crystal, viewed parallel to the axis of bending. For photographing, the sample was immersed in ethylene iodide and illuminated by transmitted polarized light. ( $\times 18$ )

The sample was then annealed in the flame for 10 minutes at a temperature of the order of  $2000^{\circ}\text{C}$ . After this treatment, striking evidence for the expected polygonization was obtained, as is shown in Fig. 3.

With this discovery of polygonization in plane bent sapphire, it was clear that polygonization of a plane bent crystal of zinc should produce an identical macrostructure. This prediction has been fully verified by my colleague, J. J. Gilman (5).

M. L. KRONBERG

Research Laboratory, General Electric Company, Schenectady, New York

#### References

1. A. H. Cottrell, *Dislocations and Plastic Flow in Crystals* (Oxford Univ. Press, ed. 1, 1952), p. 29.
2. R. W. Cahn, *J. Inst. Metals* 76, 121 (1949).
3. E. L. McCandless and D. M. Yenni, U.S. Patent No. 2,485,979 (1949); J. B. Wachtman and L. H. Maxwell, *J. Am. Ceram. Soc.* 37, 291 (1954).
4. C. D. West, *ONR Tech. Rept. No. N7ONR-39102* (1952); J. F. Nye, *Acta Metals* 1, 153 (1953).
5. J. J. Gilman, *Acta Metals* 3, 277 (1955).

17 June 1955

#### On Responsibility of Scientists

In his informative article, "The work of many people" [*Science* 121, 267 (1955)], Edward Teller discusses the role of scientists in the development of the atom and hydrogen bombs. I feel that, in view of the fundamental assistance that the scientist might give in helping to understand and ameliorate the present world tension, I should present to the readers of *Science* a humanistic point of view, which I am sharing with others and which is at least complementary to the one set forth by Teller.

I fully realize that the purpose of Teller's article was not the discussion of the wider cultural background against which the development of the atom bomb must be seen. Yet in the last two paragraphs the awful gravity of the human situation springs into focus. Teller states: "... I also believe that we would be unfaithful to the tradition of Western civilization if we were to shy away from exploring the limits of human achievement. It is our specific duty as scientists to explore and to explain. Beyond that our responsibilities cannot be any greater than those of any other citizen of our democratic society. ... To be in possession of this instrument [thermonuclear weapon] is an even greater challenge to the free community in which we live. I am confident that, whatever the scientists are able to discover or invent, the people will be good enough ... to control it for the ultimate benefit of everyone."

Teller's faith in the organizing ability

of the human community is a healthy sign, but we must also admit that there are many who have long observed the dangerous course that Western civilization has been taking, and they are alarmed that atom and hydrogen bombs have, at this point, become, so to speak, the symbol of man's ability or inability to practice ordinary human virtues on a world-wide scale. The mere creation of fear and of weapons has in the past never produced a turn of heart among potential trouble makers. The delicate equilibrium of international and interhuman relationships is now taxed to the utmost by conflicting ideologies and self-propelling material interests. So, many of us would rather not wait until the control of those disorganizing forces becomes even more urgent as a result of more dreadful external catastrophes. One of the chief dangers is that we continue to apply too simple and too static a formula to the present situation. We scientists are readily tempted to succumb to this tendency, since, in the traditional thinking of science, the idea of automatic scientific and social progress has been prominent. I believe that our hope lies in an ever-growing understanding of the psychological and historical factors that control man's destiny and that everyone should try to acquire and help to disseminate such understanding. Let me be more specific.

The majority of scientists, in speaking of the principles of their profession, readily identify themselves with an ideal that has its main origin in the 17th-century individualistic and cultural renaissance. But history shows that the purity of an original ideal, whether religious or scientific, whether envisioned by an inspired individual or a small brotherhood, changes when it is forced to operate within the more material medium of human society. Science has been no exception to this process, which was pointed out especially by Lewis Mumford and Arnold Toynbee. "Why is this secular cult of science," wrote Toynbee (*New York Times Magazine*, 26 Dec. 1954), "not enough? Because science operates in a medium from which it can never detach itself. Our Western science is the child of moral virtues; and it must now become the father of further moral virtues if its extraordinary material triumphs in our times are not to bring human history to an abrupt, unpleasant and discreditable end. ... The virtues of prudence, self-control, tolerance, wisdom, and—far above all these—love have become necessities of life in the literal sense."

There are, I am confident, many among us who share this growing general awareness that such laws of human behavior are now more important than material interests, theories of supply and demand, systems of attack and counterat-

tack, and so forth. In the necessary process of spiritual renewal and of humanization of social behavior, the scientist can and must accept a load as heavy as that which any other responsible citizen will bear. He will accept more than his share if he pauses to compare the spirit from which science originally sprung with the present threat of total scientific extermination. But he will be doing less if he harbors the notion that his human duty ends with professional achievement or with his gifts of technical results and inventions.

ROBERT BLOCH

Biological Abstracts,  
University of Pennsylvania, Philadelphia  
4 March 1955

I am convinced that one should consider the consequences of technical developments extremely seriously. On the other hand, the effect of these technical developments, and especially of these new weapons, is clear enough to every thinking person. Under these circumstances, there is no reason to believe that a scientist has more sound judgment in the evaluation of the impact of discoveries than any public-minded person. I am, of course, very much interested in the impact and the consequences of these discoveries, but I feel that there is a danger that whatever opinion I voice in this matter may be taken too seriously because of the accident that I happened to be a part of the development. In my article, I felt that it would be of most help to remind the reader of the confidence we should have in one another as human beings in solving such difficult problems.

EDWARD TELLER

Department of Physics,  
University of California, Berkeley  
1 August 1955

### On "An Application of Statistics"

In a recent communication [*Science* 121, 402 (1955)] Frederick Sargent reported a coefficient of simple linear correlation of  $-0.611$  between the number of letters in the name of a month and the mean monthly precipitation at Chicago in that month. He states that "this association was significant at the 5-percent level," and gives a value of  $0.05 < P < 0.025$ . (Presumably the signs of inequality have been reversed through an error of typesetting.) He goes on to say that "these associations have proved to be useful teaching examples of what can be

done by the application of statistics, for here are significant correlations without *a priori* or *a posteriori* bases."

The example is, indeed, a useful one, although the interpretation might differ from that implied. Sargent says that he has been "searching for a phenomenon that would illustrate" the truism that "the mere fact that two variables are significantly correlated by accepted statistical treatment of valid observations does not *ipso facto* prove that the correlation has any biological meaning." In his search, he turned up this example (and another that he describes as "suggestive but not statistically significant.")

If Sargent's search covered as many as 20 examples, we would expect, even though there was not correlation on an *a priori* or *a posteriori* basis, that one of the samples might be "significant at the 5-percent level." This means merely that the sample shows as much correlation as one would get one time in 20 from uncorrelated data.

Sargent's example does not in any way indicate that the statistical methods are wrong, or that "one can prove anything by statistics." It indicates merely that he had patience enough to look through a score or more of cases for a class illustration. His results are useful enough so that I shall be glad to use them with my own students.

ALBERT E. VAUGH

Department of Economics,  
University of Connecticut, Storrs  
19 August 1955

### Proliferation of Mature Fruit Pericarp Tissue Slices *in vitro*

The comparatively high rate of metabolic activity of the avocado fruit (1) has suggested that an investigation of the developmental histology might offer an explanation of this rather unusual physiological behavior. Studies of the mitotic activity and cell enlargement in the mesocarp, which comprises the major portion of the rather homogeneous pericarp, have indicated that maximum cell volume is attained when the fruit reaches about half its ultimate size and that cell division in the pericarp continues throughout the fruit life on the tree (2). Most other fruits reported in the literature are characterized by a period of cell division that lasts from 2 to 4 weeks following pollination. Subsequent fruit-size increase then results almost entirely from cell enlargement.

The rather unusual mitosis-cell enlargement relationship within the avo-

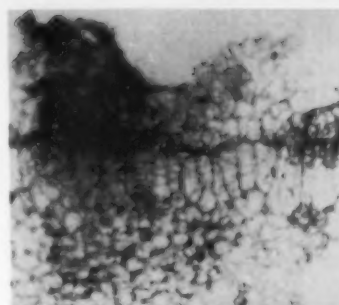


Fig. 1. Proliferation of tissue disks from mature avocado fruits grown on agar nutrient media.

cado and the physiological behavior suggest the maintenance of a juvenile state throughout the fruit life or a continuous meristematic condition of the "otherwise mature" pericarp parenchyma. Attempts have been made to tissue-culture this pericarp wall, the cells of which contain large amounts of oil.

Disks of tissue 8 mm in diameter and 1 mm thick from horticulturally mature fruit were planted on agar media, utilizing a general formula (3). Within 3 or 4 weeks cellular proliferation on the upper surfaces of the disks has been observed (Fig. 1). This has resulted in some cases from the development of a parenchymatous cell mass over the entire upper surface, giving rise to a "pad" six to eight or more cells thick. Some disks develop a meristematic layer parallel to, and three or four cells layers beneath, the exposed surface. A few disks have produced clusters of cells from isolated areas at apparent random points on the upper surface of the disk. There has been little indication of tissue differentiation under the limited environmental conditions studied. Attempts are now under way to investigate the environmental factors that affect these cultures and to make subcultures of these proliferating cell masses.

Although reports exist concerning culture of ovaries and other tissues of immature fruits, it is thought that proliferation *in vitro* of pericarp tissue from horticulturally mature fruit has not been demonstrated previously.

C. A. SCHROEDER

Department of Subtropical Horticulture,  
University of California, Los Angeles

#### References

1. J. B. Biale, *Proc. Am. Soc. Hort. Sci.* 39, 137 (1941).
2. C. A. Schroeder, *Proc. Am. Soc. Hort. Sci.* 61, 103 (1953).
3. J. Nitsch, *Am. J. Botany* 38, 566 (1951).

13 June 1955

## Book Reviews

### Approximations for Digital Computers.

Cecil Hastings, Jr., assisted by Jeanne T. Hayward and James P. Wong, Jr. Princeton Univ. Press, Princeton, N.J., 1955. viii + 201 pp. \$4.

The advent of automatic computing machinery has raised a host of problems and necessitated a thoroughgoing reexamination of numerical techniques. A striking example of this is to be found in the treatment of special functions. The computer whose only mechanical aid is a desk calculator must lean heavily upon tables. If a differential equation is to be solved, the first endeavor will be to express the solution in terms of tabulated functions. Even an expansion into an infinite series of such functions may be worth while, provided that the convergence is fast enough that relatively few terms contribute significantly to the result.

The use of punched-card machines did not substantially affect this approach. Numerous tables were set up on punched cards at various computing centers and often made available for duplication as needed elsewhere. Apart from the ad hoc methods of circulation, the major novelty lies in the tendency toward higher-order interpolation to permit reducing the number of tabular entries. The Harvard MARKS, all slow by current standards, and the ENIAC, with very limited general purpose storage, each had a few tables built in.

With most of the machines that have begun operating during the current decade, the built-in table has been abandoned, and for several reasons. An obvious factor is that the built-in table ties up a great deal of hardware that might better be used more flexibly, although this was probably as true of the ENIAC, which had tables, as of the UNIVACS which have none. More to the point is the fact that at current speeds it is generally more economical to compute a function, from a power series or continued fraction, or even by solving numerically a differential equation, than it is to refer to a table and do the necessary interpolation. An exponential, for example, can be computed in a few milliseconds whenever needed, under the direction of a program prepared once and for all and

occupying only a very small amount of memory space. This very fact implies that there is less need for the function itself than would otherwise be the case. Instead of attempting to transform a differential equation into a form whose solutions are tabulated, one will attempt to transform it into a form more readily amenable to direct numerical solution.

Nevertheless, the need for evaluating special functions has certainly not disappeared, and, furthermore, there is a higher synthesis of the superficially disparate points of view. Clearly in its actual utilization a power-series expansion is always truncated, and it therefore provides only a polynomial approximation to the function. But a table itself ordinarily provides also, by way of a suitable algorithm, a polynomial approximation, or rather many such, according to the interval and the interpolatory technique. But if, in either case, the function is being represented by a polynomial, it seems in order to make a direct attack and ask explicitly for the best polynomial.

The problem of obtaining an optimal representation of an arbitrary, but fixed, continuous function by means of a polynomial of given degree was investigated extensively by the Russian mathematician Chebyshev about a century ago and has been under study ever since. *Optimal* means, here, that the maximal departure of the representation from the function being represented is minimized. Chebyshev proved the basic theorems. If one allows the polynomial to be of degree  $n$ , then there will be  $n+2$  points at least where the maximum departure is actually reached. It is understood that the representation is required over only a given finite segment of the  $x$ -axis. The best approximating function then exists and is even unique.

For machine purposes one can just as well use a quotient of two polynomials instead of a single one. The theory is very much the same, and the flexibility is much greater. In either event the machine has only to store the coefficients (usually six or seven) and a short program to direct the evaluation of the polynomial or fraction.

Unfortunately the proof of the existence of the best approximation is not a constructive proof, and although the best

approximations are known for a few simple functions, these are very few indeed. Every case must be handled laboriously on its own. During the late 1940's, Cecil Hastings of the Rand Corporation began constructing Chebyshev approximations (or approximately (!) Chebyshev approximations) for various functions arising in the course of the computing at Rand. The "Hastings approximations" came to be well known and rather extensively used in this country and, doubtless, abroad. The approximations themselves, with error plots, were circulated, but without explanation, and the results gave no hint as to how one might go about constructing other approximations or improving upon those available.

The present little volume is designed to let the computing world in on the preparation and to collect together some of the results. Almost as laconic as the original memoranda, the volume is made up of a series of sketches, each with a brief legend. These illustrate the basic Chebyshev theorem and proceed step by step to show how one can start with an initial crude approximation and subsequently improve it. There are no mathematical demonstrations, but the presentation is admirably intuitive. The computing world is greatly indebted to Hastings for this tour of his workshop.

A. S. HOUSEHOLDER

Mathematics Panel,  
Oak Ridge National Laboratory

### Speech: Code, Meaning, and Communication.

John W. Black and Wilbur E. Moore. McGraw-Hill, New York-London, 1955. vii + 430 pp. Illus. \$4.50.

This book is distinctive in its field by virtue of the information it contains about the neurophysiological processes of abstracting and projecting that are necessarily involved in speaking. These basic organic activities are either disregarded or markedly subordinated to other matters in most textbooks concerned with speech. By comparison, therefore, this textbook by John W. Black, of Ohio State University, and Wilbur E. Moore, of Central Michigan College of Education, is distinguished by its vital and meaningful treatment of vocabulary, meaning, evaluative reactions, logic, probability, semantics, and the related facets of communicative behavior. Any old grad who gets as far as Chapter 6, "The speaker's meanings: speech and evaluation," is likely to wedge a forefinger in the book at that point and go looking for his old speech teacher to show him how he could have made "Freshman Speech" a whale of an interesting and significant course.

Other aspects of speech, dealt with in



traditional textbooks, are covered in this book also. These include the anatomy and physiology of the speech mechanism, phonetics, acoustics, gesture and body movement in speaking, the organization of speeches, types of speeches, motivational appeals, and oral style.

The level at which the authors treat their subject is definitely introductory; they state in the preface that their coverage of subject matter is "general in nature and limited in detail" and that they assume the student will eventually take more advanced courses. It is a sobering comment on our high schools that a beginning textbook at the college level, even one written by authors whose sensitivity to the depths and ramifications of their field is clearly evident, would reflect as much regard as this one does for the representative freshman's unfamiliarity with anything resembling substantial knowledge and the discipline involved in theorizing.

The major purpose of the authors appears to be that of stimulating the student's interest in speech, and they provide an abundance of practical exercises, materials to be analyzed and evaluated, and suggestions for speaking performances. Moreover, as has been suggested, they introduce the student to ways of thinking about thinking and talking about talking that are decidedly likely to be corrosive of apathy and self-satisfaction. After studying this book it should be harder for the student to feel at home at home and easier for him to live comfortably, and even a bit creatively perhaps, in mid-air, which is where modern men seem to have taken up their abode for the foreseeable future.

WENDELL JOHNSON

*Speech Pathology and Psychology,  
University of Iowa*

#### Methods of Quantitative Micro-Analysis.

R. F. Milton and W. A. Waters, Eds. St. Martin's, New York, and Arnold, London, ed. 2, 1955. xi + 742 pp. Illus. \$15.

Quantitative microanalysis has grown so rapidly that the editors found it necessary to revise and expand the first edition of this book, which appeared in 1949. Two chapters have been added: one dealing with chromatographic analysis and the other describing microbiological techniques, each written by specialists in the respective field. Of necessity only comprehensive presentations of typical examples of each experimental method have been included, but each has been augmented by fully referenced tables of similar published analytic procedures placed at the end of each chapter. Thus it has been possible to present a repre-

sentative account of modern microanalysis in one volume.

The book consists of eight parts and covers the following topics: gravimetric and general microchemical techniques, microanalysis of organic compounds, volumetric analysis, colorimetric analysis, electrochemical methods of microanalysis, gasometric methods of microanalysis, chromatographic analysis, and biological methods of microanalysis. Apparatus and the presentation of data are well illustrated with figures. Author and subject indexes conclude the book. The printing, paper, and binding are good.

The second edition of this valuable book will be welcomed by all analysts who make use of microtechniques.

JOHN H. YOE

*Department of Chemistry,  
University of Virginia*

**Elementary Theory of Nuclear Shell Structure.** Maria Goeppert Mayer and J. Hans D. Jensen. Wiley, New York; Chapman & Hall, London, 1955. xiv + 269 pp. Illus. \$7.75.

This is a good book for those who want to evaluate the current status of the nuclear shell model and for those who want to get a short, clear summary of the fundamental concepts and salient facts of nuclear physics today.

Since the proposal of the shell model in its present form in 1949, mainly by the authors of this monograph, it has become a dominant idea in nuclear physics. Although it is not yet derivable from laws about nuclear forces, it nevertheless provides a satisfactory framework for systematizing hundreds of facts about both stable and radioactive nuclei. It is perhaps the concept most used by the nuclear scientist today in assimilating new data. Do they or do they not conform to shell-model expectations? If not, are they related to other misfits?

Here will be found comprehensive discussions of nuclear moments, beta decay, gamma radiation, and light nuclei in relation to the model. Conveniently collected in this one book are Schmidt diagrams, graphs showing variation as a function of nucleon number of quadrupole moments, isotope shifts, energies of first excited states of even-even nuclei, tables of ground state data, beta-decay data, stripping-process data, and so on. The authors realize that a possible step toward understanding why the shell model works so well is the assessment of its breakdowns. The failures of the model are carefully pointed out. Some of the individual chapters have interesting summaries, but there is no over-all summing up.

The experienced scientist may be dis-

appointed at the lack of a fairly complete bibliography of theoretical papers related to the model. The authors excuse this deficiency on the grounds that the book is intended as an introduction and not as a compilation.

The brevity and compactness will appeal to the beginning student or nuclear technologist who wants to familiarize himself with ideas fundamental in all nuclear discussions today. For the newcomer this book offers many short, but beautifully clear, explanations of such concepts as parity, isobaric spin, pairing energy, nuclear matrix element. There is a convenient review of atomic structure to help with the nuclear ideas. Acquaintance with quantum mechanics is taken for granted. Mathematical details are not omitted but are collected in several appendices. Indeed, as the authors clearly intend, the novice can gain, with the help of this book, a pretty good working knowledge of the main facts about radioactivity and stable nuclei. He will find quickly in what a spectacular way many of these facts are given order and meaning by the shell model and will learn certain of the limitations of this systematization. These perceptions will illuminate the whole field of nuclear physics for him and will perhaps lead him to the deeper understanding of nuclear structure we are all seeking today.

KATHARINE WAY

*National Research Council*

#### Canadian Cancer Conference. vol. I.

Proceedings of the first Canadian Cancer Research Conference, Honey Harbour, Ontario, 16 June 1954. R. W. Begg, Ed. Academic Press, New York, 1955. xii + 443 pp. Illus. \$8.80.

The Canadian National Cancer Institute ensembled grantees and research fellows from all over the country to a 4-day informative conference in which 33 Canadian, one Danish, and seven United States scientists discussed results and methods of experimental cancer research. The main issues were induction and transplantation of tumors (8 papers), tumor-host relationship (9 papers), enzymes and metabolism (9 papers), and biological effects of ionizing radiations (3 papers). In some studies, developments in the respective fields were extensively reviewed (Andervont, Armstrong, Furth, Johns, McHenry, Mider, More, Parker, Quastel, Rossiter); in others impressive accounts were given on laboratory research in Canada (Allard, Begg, Cantero, Franks and associates, Goranson, McEwen, Selye, Skipper, Skoryna and others).

Four papers dealt with human cancer and cancer in general. The conference

got the most thorough up-to-date surveys on epidemiology of lung cancer (Hueper) and of lung cancer in Canada (Phillips). Engelbreth-Holm thoughtfully spoke on classification of tumors, but some of his statements are conflicting with facts—for example, “the presexual years are noteworthy in freedom from tumor development”—and some other statements are questionable—for example, “the differentiation may be changed, but always in the form of a decline.” (In man, no age is free of cancer, and early childhood, up to 4 years, has even a higher frequency than later childhood. Differentiation may proceed in some tumors, for instance in sympathoneuroblastoma, up to the point of maturation.)

The most difficult problem—the nature of cancer—was reserved for P. E. Steiner. In his excellently organized paper, he diligently argued point for point against current theories such as embryonal rests, virus, mutation, and chemical theories, suggesting instead *parthenogenesis in somatic cells* as a theory that meets all objections. In my opinion the conference should have been told by Steiner that his theory is a revival of Boveri's 40-year-old concept, experimentally supported by Fr. Levy (see my *Cancer in Man* pp. 496–497).

SIGISMUND PELLER  
New York, N. Y.

**Letalfaktoren in ihrer Bedeutung für Erbpäthologie und Genphysiologie der Entwicklung.** Ernst Hadorn. Georg Thieme, Stuttgart, 1955. 338 pp. Illus. \$9.30.

The study of hereditary lethal factors has since long occupied a position of particular significance in genetic investigations. Yet, Ernst Hadorn's book presents for the first time a monographic review and critical evaluation of our knowledge of this many-faceted subject. Following introductory terminological discussions, the early chapters of the book deal with types of evidence for and methods of demonstrating the presence of lethal factors, with ways and means of their maintenance, with their origin by natural or induced mutation, and with the chromosomal morphology of lethal factors. Brief discussions are devoted to dominant lethal factors, polyfactorial lethality, and the role of maternal and extranuclear agencies. More extensive reviews are concerned with penetrance and expressivity, modes of transmission and expression, stage specificity of action, specificity with reference to cell types and organs, pleiotropism, cellular autonomy as studied by transplantation and explanation, the evidence from phenocopy experiments, biochemical traits produced by lethal mu-

tants, and metabolic changes in their presence. The question of economic losses caused by lethal factors is given brief consideration, and there is an interesting concluding discussion of the problem of developmental integration of mutations.

This sketchy enumeration of contents may suffice to indicate the comprehensiveness with which the subject has been treated, but it does not bring out the much greater merits of the book, namely, its exceptional clarity of exposition, its masterly integration of all aspects of lethal mutations, and its skillful disclosure of the most serious gaps in our present knowledge. The illustrations, especially a number of very successful diagrams, deserve particular mention.

WALTER LANDAUER  
Department of Animal Genetics,  
University of Connecticut

**Radiation Biology. vol. II, Ultraviolet and Related Radiations.** Alexander Hollaender, Ed. McGraw-Hill, New York-London, 1955. x + 593 pp. Illus. \$8.

This series of three volumes is a present-day version of *The Biological Effects of Radiation* edited by B. M. Duggan, which was published in 1936. Volume II deals mainly with the effects of ultraviolet radiation, but it also includes some material dealing with ionizing radiation. The first half provides a general background of information on radiation, and the second half covers various biological effects of radiation. Topics not found in the earlier work include radiation of virus, photoreactivation, induction of cancer and sunburn.

The various subjects are covered very completely, for example the chapter on solar radiation includes a brief description of x-ray and radio emission from the sun. Most of the work of the period 1936 to 1951 is critically reviewed, and extensive lists of references are given. Several of the authors have made very skillful use of tables in presenting summaries of related papers. In addition, most of the authors present summaries of the present state of knowledge in their respective fields.

It is unfortunate that the publication of this volume required so much time; most of the articles are dated 1951 or 1952. The value of review articles decreases with a “half-life” of perhaps 7 years, so a 3-year delay causes a serious loss. With the present mass production of scientific literature, however, volumes such as this that summarize a vast quantity of information are indispensable.

Titles of the chapters are as follows: “Photochemistry,” Robert Livingston; “Practical applications and sources of

ultraviolet energy,” L. J. Buttolph; “Sunlight as a source of radiation,” J. A. Sanderson and Edward O. Hulburt; “Technique of study of biological effects of ultraviolet radiation,” Jesse F. Scott and Robert L. Sinsheimer; “Ultraviolet absorption spectra,” Robert L. Sinsheimer; “A critique of cytochemical methods,” A. W. Pollister; “The effect of ultraviolet radiation on the genes and chromosomes of higher organisms,” C. P. Swanson and L. J. Stadler; “The effects of radiation on protozoa and the eggs of invertebrates other than insects,” Richard F. Kimball; “Radiation and viruses,” S. E. Luria; “Effects of radiation on bacteria,” M. R. Zelle and Alexander Hollaender; “Radiation studies on fungi,” Seymour Pomper and Kimball C. Atwood; “Photoreactivation,” Renato Dulbecco; “Sunburn,” Harold F. Blum; and “Ultraviolet radiation and cancer,” Harold F. Blum.

RICHARD B. ROBERTS  
Department of Terrestrial Magnetism,  
Carnegie Institution of Washington

**Aux Confins de la Vie.** Perspectives sur la biologie des virus. P. Morand. Masson, Paris, 1955. 171 pp. F. 350.

This small French book, with the appropriate subtitle “Perspectives on the biology of viruses,” appears to have been written for a sophisticated audience of nonspecialists by an exceptionally well-read nonspecialist. Both its merits and defects stem from the fact that its author is not a “practicing virologist.” Its merits are unabashed enthusiasm, lack of axes to grind in any specific area of the subject, and willingness to make rapid transitions from the factual to the speculative and on to the philosophic. Its defects are the relative high incidence of minor factual mistakes and, more basic, the lack of informed discrimination among contributions and opinions of varying standing and actuality. Altogether, however, this is high-class, stimulating, semipopular science writing, deriving its appeal from the world of ideas rather than from the realm of practical interests, to which most popular science books seem to cater.

The subject matter is divided into three major sections, dealing with viruses as physical, chemical, and biological entities, respectively. These are preceded and followed by shorter, more speculative chapters. The author succeeds in condensing into these few pages an amazing amount of the information that biologists and biochemists today consider essential to the study of virology as a fundamental science. Much of the condensed material has been predigested somewhat hastily and is more likely to



stimulate the reader to further study than to provide him with adequate knowledge. This makes it regrettable that despite the numerous quotations and mentions of original contributions the book does not provide a list of references. A short list of suggested books preceding the text may serve as a lead to bibliography.

S. E. LURIA

Department of Bacteriology,  
University of Illinois

## Books Reviewed in The Scientific Monthly October

*Cultural Anthropology*, Melville J. Herskovits (Knopf). Reviewed by M. H. Fried.  
*The Evolution of an Insect Society*, Derek Wragge Morley (Scribner). Reviewed by Reginald D. Manwell.

*Readings in Anthropology*, E. Adamson Hoebel, Jesse D. Jennings, Elmer R. Smith, Eds. (McGraw-Hill). Reviewed by Alfred G. Smith.

*Animal Life in Deserts*, P. A. Buxton (St. Martin). Reviewed by Paul B. Sears.

*Evolution of the Vertebrates*, Edwin H. Colbert (Wiley; Chapman & Hall). Reviewed by Albert E. Wood.

*Grundriss der Allgemeinen Zoologie*, Alfred Kuhn (Thieme). Reviewed by Ernst Caspari.

*Introduction to Physical Geology*, Chester R. Longwell and Richard Foster Flint (Wiley; Chapman & Hall). Reviewed by Jacob Freedman.

*Two Years in the Antarctic*, E. W. Kevin Walton (Philosophical Library). Reviewed by V. E. Fuchs.

*Science Reasoning and Understanding*, Intercollege Committee on the Evaluation of Science Objectives of the Cooperative Study of Evaluation in General Education (Brown). Reviewed by I. Bernard Cohen.

*The Chemistry of Living Cells*, Helen R. Downes (Harper). Reviewed by L. J. Mullins.

*Botany Principles and Problems*, Edmund W. Sinnott and Katherine S. Wilson (McGraw-Hill). Reviewed by Robert F. Smart.

*The Elements of Chromatography*, Trevor Illtyd Williams (Philosophical Library; Blackie). Reviewed by James D. O'Rourke.

*Soil Fertility*, C. E. Millar (Wiley; Chapman & Hall). Reviewed by Roy D. Hockensmith.

*Minerals in World Industry*, Walter H. Voskuil (McGraw-Hill). Reviewed by William A. Hance.

*Experiments in Organic Chemistry*, Louis F. Fieser (Heath). Reviewed by Roy G. Bossert.

*The New Warfare*, O. N. Barclay (Philosophical Library). Reviewed by Ralph Braibanti.

*Applied Entomology*, H. T. Fernald and Harold H. Shepard (McGraw-Hill). Reviewed by J. S. Wadé.

*Physics: a Descriptive Interpretation*, C. H. Bachman (Wiley; Chapman & Hall). Reviewed by R. F. Paton.

## New Books

*Chemotherapy of Malaria*, Gordon Covell, G. Robert Coatney, John W. Field, Jaswant Singh. WHO Monogr. Ser. No. 27. World Health Organization, Geneva, 1955. 123 pp. \$3.25.

*The Hormones*. Physiology, chemistry and applications. vol. III. Gregory Pincus and Kenneth V. Thimann, Eds. Academic Press, New York, 1955. 1012 pp. \$22.

*Laboratory Outlines and Notebook of Organic Chemistry*, Cecil E. Boord, Wallace R. Brode, Roy G. Bossert. Wiley, New York and Chapman & Hall, London, ed. 3, 1955. 314 pp. \$3.90.

*Boundary Layer Theory*, Hermann Schlichting. Trans. by J. Keestin. McGraw-Hill, New York; Pergamon, London; Braun, Karlsruhe, Germany, 1955. 535 pp. \$15.

*The Miracle of Light and Power*. How electricity, gas and steam are produced for home and industry. Burr W. Leyson. Dutton, New York, 1955. 186 pp. \$3.50.

*Qualitative Organic Analysis and Scientific Method*, A. McGookin. Chapman & Hall, London; Reinhold, New York, 1955. 155 pp. \$4.50.

*Stuttering in Children and Adults*. Thirty years of research at the University of Iowa. Wendell Johnson, Ed. Univ. of Minnesota Press, Minneapolis, 1955. 472 pp. \$5.

*Principles of Meteorological Analysis*, Walter J. Saucier. Univ. of Chicago Press, Chicago, 1955. 438 pp. \$10.

*Recent Progress in Hormone Research*. vol. XI. Proceedings of the 1954 Laurentian Hormone Conference. Gregory Pincus, Ed. Academic Press, New York, 1955. 518 pp. \$10.

*Fifth Symposium (International) on Combustion*. Combustion in engines and combustion kinetics. Standing Committee on Combustion Symposia of the Combustion Institute. Reinhold, New York; Chapman & Hall, London, 1955. 802 pp. \$15.

*The Convolution Transform*, I. I. Hirschman and D. V. Widder. Princeton Univ. Press, Princeton, N.J., 1955. 268 pp. \$3.50.

*Textbook of Anatomy and Physiology*, Diana Clifford Kimber and Carolyn E. Gray. Rev. by Caroline E. Stackpole and Lutie C. Leavell. Macmillan, New York, ed. 13, 1955. 850 pp. \$5.

'Sound Barrier.' The story of high-speed flight. Neville Duke and Edward Lanchbery. Philosophical Library, New York, rev. ed., 1955. 129 pp. \$4.75.

*Advances in Internal Medicine*. vol. VII. William Dock and I. Snapper. Year Book, Chicago, Ill., 1955. 311 pp. \$8.50.

*Culture and Experience*, A. Irving Halliwell. Univ. of Pennsylvania Press, Philadelphia, 1955. 434 pp. \$7.

*Discovering Buried Worlds*, André Parrot. Trans. by Edwin Hudson. Philosophical Library, New York, 1955. 127 pp. \$3.75.

*The Principles of Electromagnetism*, E. B. Moullin. Oxford Univ. Press, Oxford, ed. 3, 1955. 438 pp. \$8.

*The Case History of Sigmund Freud*, A. psychobiography. Maurice Natenberg. Regent House, Chicago, 1955. 245 pp. \$3.95.

## Miscellaneous Publications

(Inquiry concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

*Eighth Annual Report. Pacific Science Board, 1954*. Natl. Acad. of Sciences-Natl. Research Council, Washington, 1955. 61 pp.

*INSDOC Report 1954-55* (Indian Natl. Scientific Documentation Centre). Natl. Physical Lab. of India, New Delhi, 1955. 18 pp.

*In Time of Trouble*. Office of Public Reports. 38 pp. *Technical Cooperation in Education*. 18 pp. International Cooperation Administration, Washington 25, 1955.

*The Research Report of the Land Locomotion Research Laboratory*. vol. 1, No. 2. The Laboratory, Detroit Arsenal, Center Line, Mich., 1955. 33 pp.

*The 14-Week Exploratory Study of Marginal-Airman Basic Training: Comparison of Proficiency of 8-Week and 14-Week Training Groups*. Research Rpt. AFPTRC-TN-55-10. Donald B. Gragg et al. 27 pp. *The Behavior of Individuals and Personnel Systems in the Surveillance Functions of an Air Defense Direction Center*. pt. III, *Distribution of Responses with Respect to Job Functions*. Research Rpt. AFPTRC-TN-55-11. Jay D. Cohen and Robert K. McKelvey. 15 pp. *Student Achievement as a Measure of Instructor Effectiveness*. Research Rpt. AFPTRC-TN-55-12. Joseph E. Morsh, George G. Burgess, Paul N. Smith. 20 pp. *Implications of Regional Differences in Aptitude for Personnel Classification*. Research Rpt. AFPTRC-TN-55-13. Mary Agnes Gordon. 13 pp. *Evaluation of a Selection Composite for Screening Applicants for USAF Officer Candidate School*. Research Rpt. AFPTRC-TN-55-15. Ernest C. Tupes and Walter R. Borg. 13 pp. *Predicting Motivation for Flying Training among Senior AFOTC Cadets*. Research Rpt. AFPTRC-TN-55-18. Ernest C. Tupes, J. W. Bowles, Donald V. Torr. 8 pp. *Air Force Personnel & Training Research Center, Lackland Air Force Base, San Antonio, Tex., 1955* (Order from: Office of Technical Service, U.S. Dept. of Commerce, Washington, D.C.)

*Air-Borne*. Cornell Rural School Leaflet, vol. 49, No. 2. Verne N. Rockcastle. Cornell Univ., Ithaca, N.Y., 1955. 32 pp.

*The Zoonoses in Their Relation to Rural Health*. Karl F. Meyer. Univ. of California Press, Berkeley and Los Angeles, 1955. 49 pp. \$1.

*A New Species of Sternotherus with a Discussion of the Sternotherus Carinatus Complex (Chelonia, Kinosternidae)*. Tulane Studies in Zoology, vol. 3, No. 3. Donald W. Tinkle and Robert G. Webb. Tulane Univ., New Orleans, 1955. \$0.50.

*First Annual Report and Statement of Accounts for the Period Ending 31 March 1955*. National Research Development Corp. of India, New Delhi, 1955. 17 pp.

*Bioestadística*. Serie Científica 2. Alfonso Dominguez Toledano. 1953. 181 pp.; *Papeles de la Chinantla*. pt. 1, *Mayultanguis y Tlacoatintepac*. Serie Científica 3. Roberto J. Weitlaner and Carlo Antonio Castro G. 1954. 269 pp. Museo Nacional Antropología, Mexico.

# Scientific Meetings

## Pacific Division Meets

The 36th annual meeting of the Pacific Division, American Association for the Advancement of Science, was held at the California Institute of Technology, Pasadena, 20-25 June 1955. Twenty-five organizations participated in a program of 345 scientific papers. The registered attendance of 1307, exclusive of 65 exhibitor registrations, was the largest ever recorded for a meeting of the Pacific Division (see Table 1). Arrangements for the meeting were ably handled by a local committee and various subcommittees, under the general chairmanship of Arthur W. Galston.

Registration headquarters were set up outdoors under a spreading Englemann oak. There are few climates in the United States where a local committee would venture this liberty with the weather; but the Pasadena climate lived up to its reputation. Throughout the week the Englemann oak provided not only a center of registration and information, but also a pleasant place for people to meet.

Exhibits of scientific books and instruments were also set up outdoors, but in the shelter of an arcade provided by the porticoes of several academic buildings surrounding a rectangle of lawn. Forty exhibitors were represented. This area also served as a gathering place for informal meeting and discussion.

On 20 June, the evening session began with addresses of welcome by Lee A. DuBridge of the California Institute of Technology and by Mayor Warren Dorn of Pasadena, followed by remarks from George W. Beadle, president of the AAAS, and Robert B. Brode, president-elect of the Pacific Division. Up to this point the proceedings had moved along according to precedent. But something new had been added. The Caltech Stock Company, made up of faculty and students, presented a musical satire of completely professional caliber entitled "This is science?" No attempt will be made here to describe the indescribable, but the general flavor of the performance can be imparted by the titles of the lyrics, some of which were "That's not gneiss," "Drosophila blues," and "Exactly IQ," and by the chorus, "Let's advance on science (before science advances on us)." A good time was had by all.

The succeeding evening programs were definitely serious in vein and were centered in the theme of "Ideas." On Tuesday evening, 21 June, Linus Pauling, chairman of the Division of Chemistry and Chemical Engineering at Caltech and 1954 Nobel laureate in chemistry, spoke on "The genesis of ideas." He was followed on Wednesday evening by Dean Rusk, president of the Rockefeller Foundation, who spoke on "The support of ideas." On Thursday evening, Will Burton, designer and visual education investigator for industry, discussed "The communication of ideas." Thus, the evening addresses constituted a well-integrated trilogy.

At the meeting of the Divisional Council on Wednesday afternoon, it was unanimously voted to invite the American Statistical Association (Los Angeles Chapter), and the Biometric Society (Western North American Region) to become affiliated societies of the Pacific Division.

J. Murray Luck, professor of chemistry at Stanford University, was elected president-elect of the Pacific Division. The president of the Division for the coming year is Robert B. Brode, professor of physics, University of California at Berkeley. Edwin R. Guthrie (University of Washington), the retiring president, be-

came chairman of the executive committee. Joseph L. Williams (Stanford University) was elected a member of the executive committee. A. H. Joy (Mount Wilson and Palomar observatories) and Walter P. Cottam (University of Utah) were elected members-at-large of the council.

The following organizations participated in the Pasadena meeting: AAAS Section B—Physics, American Chemical Society (Southern California Section), American Meteorological Society, American Nature Study Society (Western Section), American Phytopathological Society (Pacific Division), American Society for Horticultural Science (Western Region), American Society of Limnology and Oceanography (Pacific Section), American Society of Plant Physiologists (Western Section), American Statistical Association (Los Angeles Chapter), Association of Pacific Coast Geographers (Pacific Division), Association of American Geographers), Astronomical Society of the Pacific, Biometric Society (Western North American Region), Botanical Society of America (Pacific Section), Cooper Ornithological Society (Northern and Southern Divisions), Ecological Society of America (Western Section), Federation of American Scientists (Los Angeles Branch), Geological Society of America (Cordilleran Section), Herpetologists League, National Science Foundation, Society of American Bacteriologists (Southern California, Northern California, and Hawaiian branches), Society for Experimental Biology and Medicine (Southern California and Pacific Coast sections), Society of Systematic Zoology (Pacific Section), Southern California Academy of Sciences, Western Psychological Association.

Table 1. Geographic distribution of registrants\*

Arizona	21	New York	4	Canada	
California†	1062	North Carolina	1	Alberta	5
Colorado	8	Ohio	2	British Columbia	6
District of Columbia	6	Oklahoma	2	England	3
Florida	4	Oregon	26	Germany	1
Idaho	0	Pennsylvania	5	Hawaii	6
Illinois	5	Texas	5	India	2
Indiana	2	Utah	40	Japan	1
Iowa	1	Vermont	1	New Zealand	2
Louisiana	1	Virginia	2	Salvador	1
Maryland	6	Washington	29	Scotland	2
Massachusetts	8	West Virginia	1	Tahiti	1
Michigan	4	Wisconsin	2	Venezuela	1
Minnesota	1	Total, continental		Yugoslavia	1
Missouri	3	United States	1271	Total, territorial and foreign	36
Montana	3				
Nebraska	2	Alaska	1		
Nevada	1	Australia	3	Total registration	1307
New Jersey	3				
New Mexico	10				

\* Italics indicates the seven states, the territory of Hawaii, and the Canadian province of British Columbia that comprise the area of the Pacific Division of the AAAS. Their combined registration was 1173, or 90 percent of the total.

† There were 135 California communities represented, including 255 registrants from nearby Los Angeles, 205 from Pasadena, 65 from Riverside, 40 from Berkeley, and 35 from Davis.



# McGRAW-HILL

**NOW READY**

**VOLUME IV of a monumental work**  
**THE INVERTEBRATES**  
**Volume IV; ECHINODERMATA**

By **LIBBIE H. HYMAN**, American Museum of Natural History

**McGRAW-HILL PUBLICATIONS IN ZOOLOGICAL SCIENCES**  
 Here is another volume of this top-bracket work on the invertebrates. It is a "must" for all invertebrate zoologists.

The book gives a complete, detailed, and modernized account of the anatomy, embryology, physiology, and ecology of the echinodermata. It reviews all available information on these matters. Although suitable for reference use in advanced courses in invertebrate zoology, this book is intended to be a treatise for advanced students and teachers of zoology.

*Other Volumes in the Series . . . . .*

**VOLUME I: PROTOZOA THROUGH CTENOPHORA**

726 pages, \$10.00

**VOLUME II: PLATYHELMINTHES AND RHYNCHOCOELA**

The Acoelomate Bilateria 550 pages, \$9.00

**VOLUME III: ACANTHOCEPHALA, ASCHEMINTHES, AND ENTOPROCTA**

The Pseudocoelomate Bilateria 572 pages, \$9.00

**OTHER IMPORTANT  
McGRAW-HILL BOOKS**

**STORER and USINGER**  
**ELEMENTS OF ZOOLOGY**  
 558 pages, \$5.50

**STORER**  
**GENERAL ZOOLOGY**  
 791 pages, \$6.50

**LABORATORY MANUAL FOR  
GENERAL ZOOLOGY AND  
ELEMENTS OF ZOOLOGY**  
 150 pages, \$2.50

**MAYR, LINSLEY, and USINGER**  
**METHODS AND PRINCIPLES  
OF SYSTEMATIC ZOOLOGY**  
 328 pages, \$6.00

**McGRAW-HILL BOOK COMPANY, INC.**

**330 WEST 42ND STREET**

**NEW YORK 36, N. Y.**

**SEND FOR  
COPIES ON  
APPROVAL**

tion, and Western Society of Naturalists.

Press coverage was unusually good. The local papers in and around Los Angeles carried a total of 1745 inches of copy regarding the meeting, the equivalent of nearly 80 full columns of newspaper.

The next meeting of the Pacific Division will be held at the University of Washington, Seattle, June 18-23 1956.

ROBERT C. MILLER

*California Academy of Sciences,  
San Francisco*

**Meeting Notes**

■ This year's annual convention of the American Society of Civil Engineers is scheduled to take place 24-28 Oct., a week later than usual. Ordinarily the convention is held during the week of the third Wednesday in October.

■ Almost 200 papers dealing with the application of science to the practical problems of protecting the health and pocketbook of consumers and farmers will be delivered at the 69th annual meeting of the Association of Official Agricultural Chemists at the Shoreham Hotel in Washington, D.C., 10-12 Oct.

The AOAC is the scientific organization of state and federal employees that develops the laboratory methods for testing soils, feeds, fertilizers, pesticides, foods, drugs, and cosmetics which are required for the enforcement of laws regulating these commodities.

At this meeting the association will release the 8th edition of its publication *Official Methods of Analysis of the Association of Official Agricultural Chemists*, a 1000-page compilation of methods of analysis for agricultural commodities that is used by law-enforcement, industrial, and research scientists throughout the world. This volume, which is revised every 5 years, was edited by William Horwitz of the U.S. Food and Drug Administration, assisted by H. J. Fisher of the Connecticut Agricultural Experiment Station, A. H. Robertson of the New York State Food Laboratory, and Helen Reynolds, assistant editor of the association.

Heading the list of speakers at the scientific sessions will be I. M. Kolthoff, chairman of the department of analytic chemistry at the University of Minnesota. He will discuss the analytic applications of the rotated platinum electrode, a newly developed electrometric method of analysis capable of detecting very minute amounts of substances.

At the banquet session George P. Larrick, Commissioner of Foods and Drugs, will be the principal speaker. W. F. Reindollar of the AOAC will deliver the presidential address at an afternoon general session. All of the sessions are open to the public. The complete program may be obtained by writing the association at Box 540, Benjamin Franklin Station, Washington 4, D.C.

**Forthcoming Events**

**October**

30-1. West Virginia Science Fair Work Conf., Weston. (D. E. Large, Science Fair Program, P.O. Box 117, Oak Ridge, Tenn.)

31-1. East Coast Conf. on Aeronautical and Navigational Electronics of Inst. of Radio Engineers, Baltimore, Md. (G. R. White, Bendix Radio Div., Bendix Aviation Corp., Towson 4, Md.)

31-4. American College of Surgeons, 41st annual clinical cong., Chicago, Ill. (P. R. Hawley, 40 E. Erie St., Chicago.)

31-5. Conf. on Solar Energy, Scientific Basis, Tucson, Ariz. (31-1 Oct.); World Symposium on Applied Solar Energy, Phoenix, Ariz. (1-5 Nov.). (M. L. Kastens, Stanford Research Inst., Stanford, Calif.)

# Everything A HOMOGENIZER SHOULD BE!

## THE VIRTIS "45" (45,000 R.P.M.)



## THE NEW LOW COST VIRTIS "23" (23,000 R.P.M.)



Both the VirTis "45" and the new LOW COST VirTis "23" possess many exclusive features which make them by far the most expedient tools yet developed for laboratory homogenization.

- UNPRECEDENTED SPEED
- AS LITTLE AS 15 SECOND HOMOGENIZING TIME
- IDEAL FOR ELECTRON MICROSCOPE PREPARATIONS, ETC.
- SAFE, AEROSOL-FREE ASSEMBLY OF TEFLON
- SUPERIOR TOP DRIVE DESIGN
- QUICK CHANGEOVER FROM MICRO TO MACRO WORK
- RUGGED, DURABLE CONSTRUCTION
- MANY HANDY, VERSATILE ATTACHMENTS

VirTis "45" gives from 100 to 45,000 R.P.M. and can readily be equipped to handle volumes from 0.2 to 450 ml.  
R63-185G VirTis "45" complete as illustrated with cooling cup, 250 ml macro flask and aerosol-free assembly ..... \$289.00

Low Cost VirTis "23" gives speeds from 100 to 23,000 R.P.M. and can rapidly be equipped to handle volumes from 0.2 to 200 ml.  
R63-185X VirTis "23" complete as illustrated with cooling cup, 250 ml macro flask and aerosol-free assembly ..... \$130.00  
R63-185Y As above with 0.5 micro flask ..... \$130.00

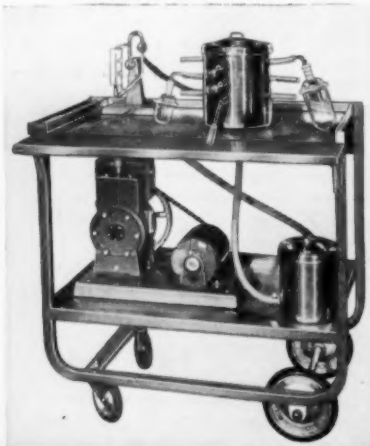
Prices F.O.B. New York, N. Y. write for detailed information

## Engineered for efficiency the VirTis FREEZE-MOBILE

A far cry from the cumbersome, time-consuming freeze-drying devices found in so many laboratories is this new Machlett exclusive—the VirTis FREEZE-MOBILE.

The VirTis FREEZE-MOBILE is compactly laid out on a free-rolling, polished stainless steel cart that may easily be moved about from place to place. It consists of a stainless steel drying unit—which may be autoclaved—a stainless Super trap, McLeod Gauge and a heavy duty 1/3 H.P., 115 Volt A.C. "DuoSeal" pump.

For detailed information about the new FREEZE-MOBILE and our many other freeze-drying apparatus and accessories, write today.



TELEPHONES:  
NEW YORK  
Lexington 2-1211  
NEW JERSEY  
Bloomfield 4-1410

### E. MACHLETT & SON

ESTABLISHED 1910

A COMPLETE SERVICE FOR THE LABORATORY

APPARATUS • INSTRUMENTS • CHEMICALS • GLASS BLOWING

220 EAST 21st STREET • NEW YORK 10, N. Y.

CABLE  
EMSONSAL  
TELETYPE  
N. Y. 1-3244

## romicron DEPRESSION SLIDE



FOR—

### Phase Contrast Tissue Culture Microscopy

- FLAT BOTTOM ground and polished
- ONE PIECE PYREX can easily be sterilized

Write for pamphlet S-23

### PAUL ROSENTHAL

505 Fifth Avenue, New York 17, N. Y.

MICROSCOPES  
ZIRCONIUM ARC ILLUMINATORS  
ROMICRON MICROPHOTOMETERS

November

1-3. Enzymes: Units of Biological Structure and Function, International Symposium, Detroit, Mich. (C. E. Rupe, Henry Ford Hospital, Detroit 2.)

2-4. American Documentation Inst., annual, Philadelphia, Pa. (S. Rosenberg, Library of Congress, Washington 25.)

2-4. Society of Rheology, annual, New York. (W. R. Willets, Titanium Pigment Corp., 99 Hudson St., New York 13.)

2-4. Symposium on Antibiotics, 3rd annual, Washington, D.C. (H. Welch, Div. of Antibiotics, Food and Drug Admin., U.S. Dept. of Health, Education, and Welfare, Washington 25.)

2-5. American Soc. of Tropical Medicine and Hygiene, Boston, Mass. (J. E. Larsh, Jr., School of Public Health, Univ. of North Carolina, Chapel Hill.)

3. American Federation for Clinical Research, Midwestern, Chicago, Ill. (R. J. Glaser, Barnes Hospital, 600 S. Kingshighway, St. Louis 10, Mo.)

4-5. American College of Anesthesiologists, Boston, Mass. (S. C. Hershey, 235 E. 22 St., New York 10.)

4-5. Central Soc. for Clinical Research, 28th annual, Chicago, Ill. (CSCR, Suite 1215, 25 E. Washington St., Chicago 2.)

4-5. Kentucky Academy of Science, Frankfort, Ky. (Mary E. Wharton, Georgetown College, Georgetown, Ky.)

(See 16 September issue for comprehensive list)



## Carworth Farms, Inc.

AKR (LEUKEMIC) MICE . . .

now available for  
immediate shipment to  
all laboratories.

For further information and price list  
please write:

**CARWORTH FARMS, INC.**

NEW CITY, ROCKLAND COUNTY, N. Y.

**'JAGABI' RHEOSTATS**  
For Fine Adjustment and Control  
of Electric Current



... with exclusive "Lubri-tact", a permanently  
lubricated sliding contact.  
Standard types in seventy-six convenient ratings.  
Write for BULLETIN 41-S D-107

**JAMES G. BIDDLE CO.**  
Electrical & Scientific Instruments  
1316 ARCH STREET, PHILADELPHIA 7, PA.

You can put your library  
in a card catalog with

## Microprint Cards



Read it in complete comfort with a

## KODAGRAPH MICROPRINT READER

Consider this: By photographic reduction, as many as sixty conventional book pages go on one side of a 3 x 5-inch card. An abstract and filing data can go on the other side. Thus, the library card catalog becomes the library itself! So great is the space-saving that individuals in an organization can conveniently have their own duplicate libraries of the literature and data they most frequently use.

You read your microprint cards in complete comfort. The Kodagraph Microprint Reader has a green screen, tilted 11° because that seems to be easiest on the eyes. Room lights need not be dimmed. The Reader takes microprint cards of any size up to 8½ x 14 inches. You feed them into the Reader like paper into a typewriter.

Many microprint publishers offer editions of standard works and periodicals. Many of these publishers are also prepared to make microprint cards of your own literature and reports.

To get started on a microprint system that can help solve the problems of debulking, speedy dissemination, and storage of literature and private internal data, mail the coupon below.

### EASTMAN KODAK COMPANY 65

Business Photo Methods Division, Rochester 4, N. Y.

Please send me the information checked:

- ☐ Where I can see a Kodagraph Microprint Reader.
- ☐ Folder on the Reader and sample microprint card.
- ☐ List of publishers of microprint cards and manufacturers of microprint cards to order.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

Kodak

# GET YOUR ADVANCE COPY

## of the General Program-Directory of the AAAS Atlanta Meeting

### by first class mail — early in December

The General Program-Directory of the 122nd Meeting of the AAAS in Atlanta, Georgia, Dec. 26-31, 1955, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

#### Program content

1. The four-session symposium, "Atomic Energy and Agriculture," arranged by ORINS.
2. The three-session program of the International Geophysical Year.
3. An AAAS-sponsored "Congress" on the shortage of young scientists and science teachers.
4. Programs of the 17 AAAS sections (symposia and contributed papers).
5. Programs of the more than 60 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Editorial Problems, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Municipal Auditorium—center of the Meeting—and hotels and campuses.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1955 Annual Exposition of Science and Industry and descriptions of their exhibits.

#### Directory content

1. AAAS officers, staff, committees for 1955.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

#### Advance Registration

Advance registration has these decided advantages: 1) You avoid delay at the Registration Center upon arrival; 2) You receive the General Program-Directory in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; 3) Your name is posted in the Visible Directory as the Meeting opens.

The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program-Directory.

#### — THIS IS YOUR COUPON FOR AN ADVANCE COPY OF THE GENERAL PROGRAM-DIRECTORY —

- 1a. ☐ Enclosed is \$2.50 for my advance Registration Fee which brings me the Program-Directory, Convention Badge, and all privileges of the Meeting.
- 1b. ☐ Enclosed is \$1.50 for only the Program-Directory. (It is understood that, if I should attend the Meeting later, the Badge—which is necessary for all privileges of the Meeting—will be secured for \$1.00 more.)  
(Check one)
2. FULL NAME (Dr., Miss, etc.) .....  
(Please print or typewrite) (Last) (First) (Initial)
3. ACADEMIC, PROFESSIONAL, OR  
BUSINESS CONNECTION .....
4. OFFICE OR HOME ADDRESS .....  
(For receipt of Program-Directory)
5. YOUR FIELD OF INTEREST .....
6. CONVENTION ADDRESS .....  
(May be added later, after arrival)

Please mail this Coupon and your check or money order for \$2.50 or \$1.50 to the  
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE  
1025 Connecticut Avenue, N.W., Washington 6, D. C.

# RESEARCH BIOCHEMICALS

OF  
HIGHEST POSSIBLE PURITY

FOR  
INVESTIGATIONAL  
USES

## Typical Derivatives

ADENOSINE TRIPHOSPHATE  
ADENINE  
ADENOSINE DIPHOSPHATE  
ADENYLIC ACID (Muscle) AMP  
2-AMINO-4-METHYL PYRIMIDINE  
COENZYME A  
COZYMASE (Coenzyme 1)  
CYTIDINE  
CYTIDYLIC ACID  
CYTOCHROME C  
CYTOSINE  
GLUCOSE-1-PHOSPHATE  
TRIPHOSPHOPYRIDINE NUCLEOTIDE  
URIDINE-5-PHOSPHATE  
XANTHOSINE

A COMPLETE SELECTION

of

NUCLEOPROTEINS and  
DERIVATIVES

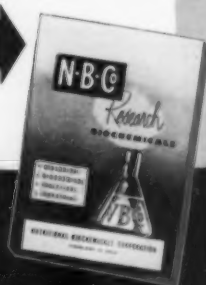
All of Highest Possible Purity



WRITE FOR  
NEW CATALOG

(August 1955)  
OVER 1500 ITEMS

Write Dept. #102



NUTRITIONAL BIOCHEMICALS  
C O R P O R A T I O N

21010 MILES AVENUE

CLEVELAND 28, OHIO

## KLETT ELECTROPHORESIS



CUSTOM MADE

TOOL FOR THE ANALYSIS  
OF COMPLEX COLLOID SYSTEMS, AND FOR  
THE CONTROL OF PRODUCTION OF  
PURIFIED PROTEINS, ENZYMES, HORMONES

KLETT MANUFACTURING CO.  
179 EAST 87TH STREET  
NEW YORK, N. Y.

# PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U.S. and 76 foreign countries—at a very low cost.

**CLASSIFIED:** 18¢ per word, minimum charge \$3.60. Use of Box Number counts as 10 additional words.

**DISPLAY:** Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$19.50 per inch
7 times in 1 year	17.50 per inch
13 times in 1 year	16.00 per inch
26 times in 1 year	14.00 per inch
52 times in 1 year	12.50 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

## POSITIONS WANTED

**Bacteriologist:** recent Ph.D.; highly qualified medical bacteriology, mycology; research experience with phages, animal viruses; chemistry background; publications; desires position in research, teaching, or industry. Box 250, SCIENCE.

**Biochemist:** Ph.D.; particularly well trained in mammalian physiology and biochemistry as related to endocrine function; 5 years teaching; several years director, research in industry. Medical Bureau (Burnice Larson, Director), Palmolive Building, Chicago.

**Medical and Biological Translations:** abstractions carefully and scientifically done by university graduate from French, German, Italian and Russian. Box 252, SCIENCE. 9/30, 10/7, 14

## POSITIONS WANTED

**Physiologist:** Ph.D.; instructor at large eastern medical college, desires teaching and/or research with opportunity to obtain M.D. Box 251, SCIENCE.

**Research Mathematician,** Ph.D.; publications, teaching; positions at research institutions and aeronautical companies, interested in research position, nuclear physics or aerodynamics. Box 254, SCIENCE.

**Virologist:** M.S., desires position as research assistant; experienced in fundamental procedures; also tissue culture experience. Box 253, SCIENCE.

## POSITIONS OPEN

(a) Assistant Bacteriologist; experience unnecessary; city public health laboratory; \$4200; lovely college city; Midwest. (b) Biochemist; M.S. with good methodology training; work with qualified Ph.D.; active laboratory, very large general hospital; Midwest. (c) Research Assistant, Bacteriology; degree required; project relates to bacteriophage of anaerobic bacteria; well-known midwestern university. (d) Veterinary Bacteriologist; duties isolation and diagnostic bacteriology, experimental animal farm; noted pharmaceutical house; to \$4500; East. (e) Manufacturing Biochemist; Ph.D.; supervise manufacture of biological products; to \$8500; large concern; East. Woodward Medical Bureau, 185 N. Wabash, Chicago.

**Chief, investigative medicine:** certified internist preferred; splendidly equipped clinical and research laboratory, metabolic ward, radioisotope unit; duties executive coordination of research entire staff and residents. Also vacancy director, radioisotope unit; general hospital, 1000 patients; affiliated Baylor Medical College; faculty appointment; citizenship required. Manager, VA Hospital, Houston, Texas.

## POSITIONS OPEN

**Creative organic chemist,** well-rounded in fundamental and practical synthetic know-how, to serve as responsible investigator in development of new pharmaceuticals; offers fine opportunity for growth and satisfaction. Box 246, SCIENCE. 9/23, 30, 10/7

**Neuropsychiatrist** for chief, neuropsychiatric service, new Veterans Administration Hospital; opportunity to open service of 80 beds; well-equipped, including EEG laboratory; board certification essential; teaching experience desirable; faculty connection available, strong medical school, to right man; active residency program now in operation in 8 specialties. Write Manager, VA Hospital, Dallas 2, Texas.

(a) Physician well trained in one of biological sciences; interesting opportunity, clinical research department; one of major pharmaceutical companies. (b) Microbiologist, preferably one experienced with infection in animals and with some background in immunology as well; experience in chemistry advantageous; duties include teaching at graduate level; well-known research institution. (c) Electroencephalography Technician; knowledge of electronics desirable; duties include animal research; large hospital; East; \$6000. (d) Clinical bacteriologist, Ph.D. or masters; association group of pathologists; large city, medical center; East. \$9-5 Medical Bureau (Burnice Larson, Director), Palmolive Building, Chicago.

**Wanted:** well-trained, board certified or board eligible young internists for assignment to full-time staff, medical service, expanding 500-bed GM&S hospital; major teaching unit affiliated with state university medical school; teaching experience and interest in clinical investigation desirable. Write Manager, VA Hospital, Dallas 2, Texas.

## BOOKS AND MAGAZINES

### AN EVALUATION OF RELATIVITY THEORY AFTER A HALF CENTURY

By C. A. Muses, M.A., Ph.D.

"Dr. Muses' study embraces several aspects of value both to technical and non-technical readers. It first of all provides an introduction to often little known historical aspects of relativity theory, throwing welcome light on the work of H. A. Lorentz, and its fundamental importance.

Secondly, it provides a clear-cut, understandable explanation of the theory in the light of its key concepts and their analysis.

Thirdly, modern contributions, such as the work of Hlavaty, are analyzed in terms of their usefulness and physical meaning, thus completing perhaps the most useful phase of a useful book, namely, its discussion of the directions in which the most advanced thinking on relativistic interpretation is tending.

Fourthly, certain original data are for the first time published, such as the relation of Cerenkov radiation to electronic aspects of relativity theory."—Mathematics Magazine

\$3.15 clothbound—\$2.15 paperbound

Distributed by

## THE FALCON'S WING PRESS

Indian Hills, Colorado

## BOOKS AND MAGAZINES

WANTED TO PURCHASE . . .  
**SCIENTIFIC PERIODICALS and BOOKS**

WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted

### Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC., Boston 19, Massachusetts

### BACK NUMBER PERIODICALS

—Bought and Sold

• Tell us what you want?—What have you to offer?

Abrahams Magazine Service

Established 1889

DEPT. P. 56 E. 13th ST.  
NEW YORK 3, N. Y.

## PROFESSIONAL SERVICES

### LaWall & Harrison

Div. S, 1921 Walnut St., Philadelphia 3, Pa.

### Food & Drug PROBLEMS

PHARMACOLOGICAL · BACTERIOLOGICAL · CHEMICAL





**SUPPLIES AND EQUIPMENT**

# ANALYSIS OF AMINO ACIDS AND PROTEINS

**SHANKMAN LABORATORIES**

2023 SANTA FE AVENUE, LOS ANGELES 21, CALIFORNIA

VITAMINS, MINERALS,  
FOODS,  
SPECIAL DETERMINATIONS

WISCONSIN  
ALUMNI  
RESEARCH  
FOUNDATION

## LABORATORY SERVICES

Project research and consultation in Biochemistry, Chemistry, Bacteriology and Entomology

Amino acid assays and biological protein evaluations • Vitamin and antibiotic assays • Chick feeding tests • Pharmacology including warm-blooded toxicity studies • Phenol coefficient determinations

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION  
P. O. BOX 2059-V • MADISON 1, WISCONSIN

## BOOK MANUSCRIPTS INVITED

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.  
**VANTAGE PRESS, Inc.** • 120 W. 31 St., New York 1  
In Calif.: 6253 Hollywood Blvd., Hollywood 28

**SUPPLIES AND EQUIPMENT**

## CONSISTENT RATS & MICE

All animals antibiotic free

**BUDD MT. RODENT FARM**  
**CHESTER, N. J.**

Breeders of a recognized strain  
of Wistar rats and W. S. mice

**'EXPERT REPAIRS'**  
of  
**POLARIMETERS of any MAKE**

Complete Reconditioning  
Adjustment of Optical System

**O. C. RUDOLPH & SONS**

Manufacturers of Optical Research & Control Instruments  
P.O. BOX 446 CALDWELL, N. J.



**PROFESSIONAL SERVICES**

## ALBINO RATS

Our mass production methods insure  
greatest uniformity and consistency

Price list on request

**DAN ROLFSMEYER CO.** ■ Phone 6-6149  
Route 3, Syene Road, Madison, Wisconsin

**MACHLETT**

Your assurance of the finest laboratory supplies,  
scientific instruments, chemicals and glassblowing.  
E. Machlett & Son • 220 E. 23rd St. • N. Y. 10, N. Y.

## FLANDERS RESEARCH FARMS

Breeders of

**WHITE  
SWISS**

and

**DBA/2  
MICE**

Box 22A, Flanders, New Jersey  
Phone Justice 4-7580

## C<sup>14</sup> COMPOUNDS

send for  
comprehensive list

**RESEARCH SPECIALTIES CO**

1148 Walnut St., Berkeley 7, Calif.

## ALBINO RATS\*

**HYPOPHYSECTOMIZED RATS**

\*Descendants of the Sprague-Dawley  
and Wistar Strains

**HENRY L. FOSTER, D.V.M.**

President and Director

**THE CHARLES RIVER BREEDING LABS.**  
Wilmington, Mass.



C<sup>14</sup>

## COMPOUNDS

DL-ALanine-2-C<sup>14</sup> ..... \$460.00/mc  
DL-Lactate-2-C<sup>14</sup> ..... 350.00/mc  
Sodium Acetate-1-C<sup>14</sup> ..... 110.00/mc

Write for complete list

**Berkeley**

division of Beckman Instruments Inc.  
2200 Wright Ave., Richmond 3, Calif.



65

## SPRAGUE - DAWLEY, INC.

**PIONEERS IN THE DEVELOPMENT OF THE STANDARD LABORATORY RAT.**

All shipments made from our new modern, quarantined colony.

**SPRAGUE-DAWLEY, INC. - P. O. BOX 2071**

Phone CEdar 3-5318.

Madison, Wisconsin

# The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT



SUPPLIES AND EQUIPMENT

SUPPLIES AND EQUIPMENT

## HOLTZMAN RAT COMPANY

We are now shipping from our new caesarean-derived disease-free, isolated colonies.

You may expect these rats to be genetically superior in vigor, uniformity, and temperament.

Rt. 4, Box 205

Madison 4, Wisc.

Phone: Alpine 6-5573

### technicon MOUNTING MEDIUM

the choice coverglass adhesive with higher refractive index • hardens quickly  
Sample? . . . Of course, just write

TECHNICON CHEMICAL COMPANY, INC.  
CHAUNCEY • NEW YORK

### GME

714 MARKET PLACE  
MADISON 3, WIS.

THE GME TRANSFERATOR MAKES  
ONE SPECTROPHOTOMETER  
DO THE WORK OF FOUR!

write for details

### STAINS

STARKMAN Biological Laboratory

• RARE  
• COMMON  
Price list on Request  
461 Bloor St., W.  
Toronto, Canada

GERMAN CAMERAS and special equipment for micro- and technical photography or for the hobbyist. Import your own. Save retailers, importers profits. (About 35%). Pay postman duty. Examples: —

EXAKTA. The only completely versatile 35mm. camera. With: —  
Automatic diaph. Zeiss Tessar F2.8 \$189. (duty \$22.)  
Automatic diaph. Ilex Wotanar F2.8 \$139. (duty \$19.)  
Automatic diaph. Schneider Xenon F1.9 \$195. (duty \$26.)  
Automatic diaph. Zeiss Biotar F2.0 \$199. (duty \$26.)

Similar prices all other famous makes. All new. Latest 1955 production in original factory packing. Parcelpost and insurance included. No other charges. Pre-payment through bank and inspection on arrival guarantee you complete satisfaction before we are paid. Experienced, (and objective) advisory service, (please specify interests and requirements), and specialists by return airmail. All transactions on money-back basis. WORLDPOST. TANGIER, MOROCCO.

## NOW OVER 5100 BIOS CHEMICALS

- Magnesium Hypophosphite
- Magnesium Oleate
- Magnesium Thiocyanate
- Maleonitrile
- Malonyl Chloride
- Manganese Arsenate
- Manganese Chromate
- Manganese Fluoride
- Manganese Glycerophosphate
- Manganese Sulfite
- Melam
- Melem
- Melibiose
- Melissa Alcohol
- Melittic Acid
- Melittic Trianhydride
- Melon
- Menthyl Valerate
- p-Mercaptobenzoic Acid
- Mercaptothiophene
- Mercury Arsenate
- Mercury Di-n-butyl
- Mercury Dichromate
- Mercury Diethyl
- Mercury Dimethyl
- Mercury Diphenyl
- Mercury Salicylate
- Mercury Tannate
- Mesaconic Acid
- Mescaline Base
- Mesoporphyrin
- Mesotartaric Acid
- Mesoxalamide

Ask for our new  
complete catalogue

BIOS

Laboratories, Inc.

17 West 60th St. New York 23, N. Y.  
PLaza 7-8171

## romicon EXPOSURE METER FOR PHOTOMICROGRAPHY

- self contained, no external wires
- instantaneous readings
- removal from microscope unnecessary
- adaptable to any standard microscope
- readings are easily taken by moving a lever



Ideal for:

Bellows Cameras  
Attachment Cameras  
Beamsplitters and  
Motion Picture Units

Write for pamphlet S-24

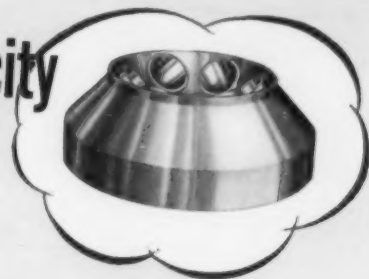
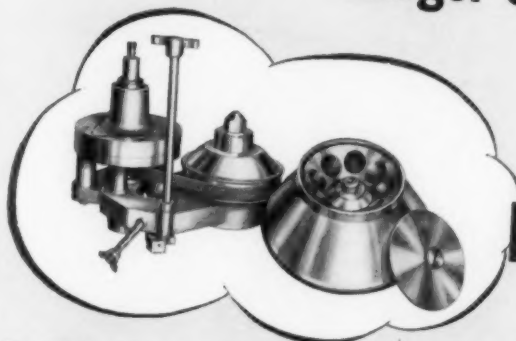
PAUL ROSENTHAL

505 Fifth Avenue

New York 17, N. Y.

Microscopes & Scientific Apparatus

Larger Capacity



Higher Speeds with

# INTERNATIONAL *Refrigerated* Centrifuges

**N**OW — New accessories give the International PR-2 Refrigerated Centrifuge these increased speeds and capacities:

400 ml. at 10,000 rpm. at 0°C. or lower  
100 ml. at 19,000 rpm. at 0°C. or lower  
4000 ml. at 2,300 rpm. at 0°C. or lower  
1500 ml. at 3,900 rpm. at 0°C. or lower

**PLUS** — 24 additional interchangeable angle and horizontal style heads and a wide variety of adapters, sealed accessories and carriers. No other cold centrifuge is so versatile.

**SEND** — for Bulletin P and information on the New High Capacity Attachment, the New 6-Place 250 ml. Angle Head and the New 4-Liter Head. If you already have an International PR-2, these new accessories will fit.

**ALSO** — the improved Model SR-3 Stationary Refrigerated Centrifuge will now swing 5200 ml. in the horizontal position at 3,000 rpm.

**FOR** — real versatility in the Refrigerated Centrifuge field — look to **INTERNATIONAL**.



**INTERNATIONAL EQUIPMENT COMPANY**  
1284 SOLDIERS FIELD ROAD, BOSTON 35, MASSACHUSETTS, U. S. A.



## POLARIZING MICROSCOPES...

- *Quality Craftsmanship Guarantees Years of Service*
- *36 Models to Choose From*

A pioneer in the evolution of polarizing microscopes, AO has developed the skills necessary to the manufacture of superb instruments. They are rugged in construction to assure years of trouble-free service while providing the top quality optics and fine mechanical function that have made AO famous as the world's largest optical manufacturer. With 36 models to choose from, some with polarizing filters and some with Ahrens prisms, an instrument can be selected which will fit every need and budget—from the beginning student to the research specialist.



No. P 37 A

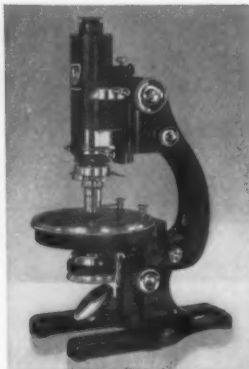


No. P 39 A

No. P 42 AC



No. P 43 AC



No. P 40 AC



**American  
Optical**

Instrument Division  
Buffalo 15, N. Y.

Dept. U5.

Please send me literature on AO Polarizing  
Microscopes.

Name .....

Address .....

City ..... Zone ..... State .....



